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ABSTRACT

The relationship between achievement and method of individualized instruction and testing was investigated using a class of 32 community college students. Construction of the mastery tests was described. For the class as a whole, students in a mastery-by-module group had slightly, but not significantly, higher scores than students in a mastery-by-objective group; but when scores from the Omnibus Personality Inventory were used to further divide the groups larger differences were noted. Eighteen separate hypotheses were tested, and five of them appeared to show significant differences. Students who studied and were tested by the mastery-by-module method did better than those who studied and were tested by the mastery-by-objective method in relation to four separate personality scores. The successful mastery-by-module students tended to be those who had low scores on Autonomy, low scores on Personal Integration, high scores on Impulse Expression and Complexity. Students using the mastery-by-module procedure who were low on Personal Integration needed fewer retake quizzes before reaching mastery. The mastery-by-module method was judged to be most appropriate for typical junior college students. (CTM)

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A STUDY OF TWO METHODS OF MASTERY RETESTING, PERSONALITY, AND ACHIEVEMENT IN A SELF-PACED INDIVIDUALIZED-INSTRUCTION MODULE

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Vernon K. Burger, M.A.

Cuyahoga Community College

A MAJOR APPLIED RESEARCH PROJECT IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF EDUCATION

NOVA UNIVERSITY

August, 1976

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Abstract of a Major Applied Research Project
Presented to Nova University in Partial Fulfillment of
the Requirements for the Degree of Doctor of Education

A STUDY OF TWO METHODS OF MASTERY RETESTING, PERSONALITY, AND ACHIEVEMENT IN A SELF-PACED INDIVIDUALIZED-INSTRUCTION MODULE

By

Vernon K. Burger

August, 1976

The purpose of this study was to investigate two methods of mastery retesting of student achievement. Selected personality characteristics were examined to determine if differences in student achievement are related to the two mastery retesting methods.

Community college students of a non-major physical science class (N=32) worked through a self-paced module on the Metric System. After formal instruction was completed, the students were randomly separated into two groups. Group A was tested with Mastery-by-Objective retests (i.e., retake only the individual objectives missed on the previous quiz) and Group B was tested ith Mastery-by-Module retests (i.e., retake all the objectives when mastery is not achieved) until mastery over the module was reached.

Achievement measures were post-test scores, number of quizzes to complete the module, and the number of days to complete the module.

Five Omnibus Personality Inventory scales entitled Autonomy, Impulse Expression, Personal Integration, Anxiety Level and Complexity were employed to describe personality characteristics hypothesized as related to student achievement and as having an interactive effect with retesting method.

The results showed that the two methods of retesting did not produce significantly different (1) mean examination scores (t-ratio = -1.81), (2) mean number of quizzes to complete the module (t-ratio = 1.19), or (3) mean number of days to complete the module (t-ratio = .45).

Analysis of the interactive effects of the two retesting methods and the selected personality characteristics was accomplished by the use of a 2 x 2 analysis of variance. The results showed that the Mastery-by-Module retesting procedure led to significantly higher post-test examination scores than did the Mastery-by-Objective retesting procedure for students classified as High Complexity, Low Autonomy, High Impulse Expression, and Low Personal Integration. Students using the Mastery-by-Module procedure who were classified as Low Personal Integration required significantly fewer quizzes than did students using the Mastery-by-Objective procedure.

It appears that the Mastery-by-Module retesting procedure can produce higher examination scores with certain students than can the Mastery-by-Objective retesting procedure.

It was recommended that the study be replicated with

a larger sample size and for a longer period of time so that the findings could be generalized further. It was also recommended that research be conducted that explores the effect on achievement of retesting methods and other components of individualized instruction systems and their interaction with the characteristics of personality.

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CHAPTER I

BACKGROUND AND STATEMENT OF THE PROBLEM

Introduction

The comprehensive community college has removed many of the barriers that often prevented students from participating in some post-secondary education experience (Cross, 1971). The admissions policies of the community college have opened doors to many students who do not possess the same aptitudes (Cross, 1971) and personality characteristics (Tillery and Kildegaard, 1973) of traditional college students. Although not a homogeneous group, these students have been labeled "Non-traditional" (Blocker, 1965), "Disadvantaged" (Roueche, 1973) and "New Student" (Cross, 1971).

Individualized instructional systems have been developed to respond to these students' differing aptitudes, learning rates, learning styles, and other needs. The difference between individualized instruction and traditional classroom instruction is clearly illustrated by John Carroll (1963).

> If students are normally distributed with respect to aptitude for some subject and all students are given exactly the same instruction (the same in terms of amount and quality of

> instruction and learning time allowed), then achievement measured at the completion of the subject will be normally distributed. Under such conditions the correlation between aptitude measured at the beginning of the instruction and achievement measured at the end of the instruction will be relatively high (typically about +.70). Conversely, if students are normally distributed with respect to aptitude, but the kind and quality of instruction and learning time allowed are made appropriated to the characteristics and needs of each learner, the majority of students will achieve mastery of the subject. And, the correlation between aptitude measured at the beginning of instruction and achievement measured at the end of instruction should approach zero. (p. 729).

Individualized instruction systems generally produce superior examination performances and higher student ratings of the instruction than do more traditional lecture discussion methods (Kulik, Kulik and Carmichael, 1974; Rowsey, 1975, Semb, 1974).

Individualized instructional systems, however, are not without problems. There has been some indication that the self-pacing feature of many individualized instruction systems may result in a high frequency of incompletes and withdrawals by students. In addition, procrastination is the most cited problem in Personalized System of Instruction (PSI or Keller Plan) courses (PSI Newsletter, 1972). Keller (1968) reported that ten to twenty percent failed to complete work in courses taught by the Personalized System of Instruction. Some studies have reported as many as seventy percent of the students failing to complete course work within the normal instructional period (Lloyd and Knutzen, 1969;

Shepard and MacDermott, 1970).

In most personalized courses, student procrastination is only moderately discouraged by some form of instructor pacing or by a combination of student and instructor pacing (Malott and Suinicki, 1969; Miller, Weaver, and Semb, 1973; Semb, Hopkins, and Hursh, 1973).

As investigators have studied the problems of student procrastination and withdrawal rate, it has been determined that the use of quizzes and examinations are perhaps the strongest and most important controller of student behavior (Semb, Conyers, Spencers, and Sosa, 1975; Vargas and Frawley, 1975).

Several studies (Belzer, 1974; Born, 1975; Peters, 1974; Semb, 1974) have looked at the effects of different testing and quizzing procedures on learning rate and achievement. Hurst (1976) reports that only the testing procedures of the individualized audio-tutorial method used in biology at Purdue University have been consistently identified as inadequate and been changed and revised many times.

In a study of four different testing procedures, Semb, Conyers, Spencer, and Sosa (1975) found that some students achieved better with certain types of testing procedures than with other types. Sutterer and Holloway (1975) found that, regardless of the type of testing procedures, the amount of course material completed by a student in the first eleven days was significantly related to the rate

in which the student completed the course. These studies suggest that individuals respond differently to testing procedures, and these differences appear early and continue throughout the course.

To gain more understanding of the effects of individual differences, researchers have looked at how students' academic performances can be affected by their individual characteristics of ability, social environment, and personality. Ability characteristics can account for less than half of the variation in academic performances (Lavin, 1965). It is well established (Athey and Trent, 1966; Cohen, 1969; Cohen and others, 1969; Cope, 1969; Lacher, 1973; Lavin, 1965; Rossmann and Kirk, 1970; Wisconsin University, 1973) that students who are academically unsuccessful in higher education have personality characteristics significantly different from those of students who are successful.

Lavin (1965) presents 158 research studies which found significant relationships between academic performance and personality characteristics. In addition, research has shown that personality characteristics also are related to preference of type of instruction (Pascal, 1971; Smith, 1973).

Purpose

The purpose of this study was to examine how two mastery retesting methods (i.e., Mastery-by-Objective method and Mastery-by-Module method) and selected personality characteristics relate to examination performance

and student progress in an individualized instruction module. Results of this study may help in the design of an instructional program better suited to the needs of community college students.

Background and Significance of the Study

The Eastern Campus of Cuyahoga Community College is an open-door, comprehensive community college. Eastern Campus attracts a diverse student population in terms of ability and personality; a recent study of personality characteristics of Eastern Campus students, Cosner (1975), using the Omnibus Personality Inventory, found that Eastern Campus norms closely approximated the national norms for community college students.

Regardless of their reading, writing or math skills, Eastern Campus students are not restricted from enrolling in courses of other academic areas (Cuyahoga Community Catalog, 1975). Perhaps because of this, the science-major courses, attrition has been high; in the nonscience major courses, content had to be revised as not to include topics requiring mathematical skills (Burger, 1974).

A number of subject areas have incorporated some forms of individualized instruction in attempts to provide greater education opportunity to a wider range of their students. For example, the mathematics area adopted a series of programmed learning texts for the remedial and college algebra courses. The mathematics area now incorporated a mastery

learning format with tutors available throughout the day and evening. Tests in the mathematics area are based on student mastery at the seventy percent level before individuals proceed to subsequent modules (Shrider, 1974). No formal study was found that evaluated the effectiveness of this program at Eastern Campus.

In the physical science area, the general chemistry sequence was restructured to follow a slightly different form of individualized instruction-evaluation (Burger, 1975). This method includes specific objectives, a combination of lecure-recitation and slide-tape learning packages, and a mastery testing procedure set at a ninety percent mastery criterion. Students receive credit only for those objectives accomplished. Once credit has been received for certain objectives, students need only retest on objectives that were not originally passed.

This general chemisty method (Burger, 1975) was predicated on assumptions that if students are required to be retested only in what they do not know on module tests (i.e., retest only in objectives missed on mastery-by-objective quizzes): 1) students will be better directed in their studies by concentrating on unlearned objectives; 2) students will feel accomplishment from reaching mastery over some objectives; 3) this step-by-step testing and feedback sequence should encourage students to continue working as they have better insight into their progress and goals; 4) the size of the learning unit is decreased as testing

proceeds; and 5) students should, therefore, have better attitudes about learning chemistry. The general chemistry testing method aims that students will complete the course in less time, with fewer retests, and that they will perform better on post-test sequence exams.

In a study of this general chemistry method, Burger (1975) found that ninety percent of the students were able to complete the general chemistry course, and these students reported very positive attitudes towards the mastery-by-objective testing method. Students felt it would not be helpful to be required again to attempt mastery over an entire module if merely some failed objectives prevented achievement of the module mastery criterion.

Summary and Statement of the Problem

To meet individual differences of students, many community college instructors have instituted some form of individualized instruction. When compared to traditional lecture discussion methods, individualized instruction methods can produce higher final examination scores and higher student attitude ratings toward instruction (Kulik, Kulik, and Carmichael, 1974; Rowsey, 1975; Semb, 1974).

Individualized instructional methods can produce problems of high student withdrawal rates and procrastination (Keller, 1968; Lloyd and Knutzen, 1969; PSI Newsletter, 1972; Shepard and MacDermott, 1970). Different testing procedures

can produce higher achievement (Belzer, 1974; Born, 1975; Peters, 1974; Semb, 1974), and more research is needed to find more effective testing methods (Hurst, 1976).

At the Eastern Campus of Cuyahoga Community College, the chemistry area developed an individualized instruction model unique with respect to the testing method used when mastery is not reached on the first testing attempt. A study of this system (Burger, 1975) found that student attitudes were positive toward this retesting procedure.

The studies by Burger (1975) of an individualized instructional method and Cosner (1975) of the personality characteristics of students, encouraged this study. The purpose of this study was to investigate (1) the testing component of individualized instruction and (2) examine selected personality characteristics to determine their relationships to post-test scores, number of quizzes to complete a module, and the number of days to complete a self-paced individualized instruction module.

Overview of Remainder of Study

The review of related literature (Chapter II) describes research studies of individualized instructional methods, including studies of the effects of different testing procedures on achievement. Chapter II also describes research involving the study of personality characteristics and academic achievement, with particular emphasis placed on the review of research utilizing the Omnibus Personality Inventory, the instrument chosen for this study. A review

of other relevant educational research involving instructional methods, personality and academic achievement is included in Chapter II, which concludes with the research questions of the studies.

The procedural steps for gathering and analyzing data, validation procedures for the module quiz questions, hypotheses and statistical treatment are presented in Chapter III. The presentation of data and statistical testing of the hypotheses are presented in Chapter IV. A summary of results, conclusions, and implications comprise Chapter V.

CHAPTER II

REVIEW OF THE LITERATURE

Literature in the field of post-secondary education supports the premise that all students can learn. For example, Bloom (1968) suggests that students may have different skills, different interests, different personality characteristics and different learning rates, but they can learn if given the proper conditons for learning. Educational psychologist Carroll (1963) has advanced the hypothesis that almost all students can learn any topic to a predetermined criterion if efficient instruction and sufficient time are provided.

B.F. Skinner (Skinner, 1955) has stated that: "If the learner fails to learn, it is the teacher's fault. With appropriate instruction; all pupils should get 'A' grades." (p.91). A teacher of Skinnerian persuasion might say: "Anyone can learn anything if the proper conditions are met. It may be that some require more time than others (i.e., more care, more experience, more background). But sooner or later, anyone can be brought to the same level of achievement." (Bugelski, 1964, p. 4).

Of course, econmics of time and resources limit the number of students who actually would master any particular subject. Nevertheless, Bloom (1968) holds that ninety-five percent of the students in a class can achieve the grade of 'A'. Prediction of the actual percentage of students who can master a task perhaps is unimportant. The critical message is that educators must provide increasingly effective instruction so that more students can be successful in their post-secondary educational experiences. It is toward the goal of improving instruction that this study is directed.

Individualized Instruction

Dissatisfaction both with the ways in which students are taught, and with how their progress is evaluated, has stimulated educators to explore and develop new technologies of instruction. As early as 1919, the public schools of Winnetka, Illinois, began using an instructional system that involved self-pacing and repeated testing of students until mastery was demonstrated (Kulik, Kulik, and Carmichael, 1974).

In the following years, scattered programs were developed and implemented; but, it was not until the early 1960s that the concept of individualized instruction became a widespread alternative to traditional forms of instruction (Kulik, Kulik, and Carmichael, 1974). Carroll (1963) and Bloom (1968) developed a theoretical model of an educational

technology which they call Mastery Learning. During this period, a number of approaches were developed, the most notable being Postlethwait's audio-tutorial methodology (Postlethwait, Novak, and Murry, 1964) and Keller's (1968) Personalized System of Instruction (PSI).

Most individualized instructional approaches specify learning outcomes in precise, measureable terms called behavioral objectives. These systems have frequent assesment and feedback, provide opportunities for remediation, and require student mastery on quizzes over small instructional units; progress through the course depends on meeting its mastery requirement (Coldeway and others, 1974). Many of the procedures used in individualized instructional approaches have been applied within traditional college teaching structures (Abramson, 1975; Williams and Lawrence, 1975; Williams, 1975).

Research on individualized instructional techniques has primarily been to compare a particular approach, such as Keller's Personalized System of Instruction (PSI), to a traditional lecture approach. Some practitioners have modified the individualized approaches and then attempted to compare them with a traditional lecture approach. Kulik, Kulik, and Carmichael (1974) reviewed 261 published and unpublished studies which evaluated the Keller plan in the teaching of science in higher education. They found that ; (1) the Keller plan in an attractive teaching method

of most students; (2) self-pacing and interaction with tutors is favored by students over traditional lecture approaches; (3) several investigators reported higher average withdrawal rates from the Keller plan courses than from lecture courses; (4) content learning through individualized instruction as measured by performance on final exams, is always equal to and usually exceeds student performances in lecture sessions; and (5) students report that they generally learn more in the Keller plan courses than in traditional lecture courses.

Other studies have shown that courses taught by the Keller plan produce a higher average level of student performance on major exams (Born, Gledhill, and Davis, 1972; Cole, Martin, and Vincent, 1975; Garren and Gathmann, 1975; Johnston and Pennypacker, 1971; Nelson and Scott, 1972; Rosati, 1975; Rowsey, 1975).

Courses utilizing the Keller plan are not without problems. For example, Keller (1968) reported a withdrawal rate in Keller plan courses of about twenty percent. Sheppard and MacDermott (1970) reported a seventeen percent withdrawal rate in PSI sections (Keller plan) as compared to six percent withdrawal in traditional sections. The studies of Miller, Weaver, and Semb (1974) and McMichael and Cory (1969) provide additional evidence of higher withdrawal rates from PSI sections, with withdrawal rates as high as seventy percent.

A PSI questionnnaire indicated that the high dropout rate was the second most cited problem in PSI classes, with student procrastination number one. (PSI Newsletter, 1972). These two problems may be related; if a student delays course work for too long, he or she may drop out in an effort to avoid failure.

Investigators have sought to resolve the problems of high rate of withdrawal from individualized instruction systems and the associated tendencies of students to delay or procrastinate on course work. To make individualized instruction more effective and efficient, these investigators have begun to analyze the components of individualized instructional systems. For example, Johnston and O'Neil (1973) examined the effects of a mastery criterion on student performance. They found that the minimum student performance required by a course determined to a high degree the actual subsequent student showing. Students required to perform at a low criterion (60 percent) level for evidence of mastery on module quizzes scored lower on final exams than did students having a higher performance criterion (90 percent). Semb (1974) found that a mastery criterion of one hundred percent correct on module quizzes produced better student final examination performances than did a lower mastery criterion (sixty percent) on module quizzes.

Studies of Testing in Individualized Instructional Systems

Assessing student performances by awarding test grades

is one of the strongest reinforcers of student behavior available to the post-secondary instructor (Vargas and Frawley, 1975). As class population sizes have grown, teachers have been more inclined to reduce evaluations of student performances to two or three objective tests (Sutterer and Holloway, 1975). Fewer tests appear to reduce the opportunity for the instructor to provide constructive feedback to the student which might improve his academic performances.

Belzer (1974) found that students tested with weekly quizzes completed a course in biology in greater numbers and achieved higher overall grades than did students tested with two midterms and a final. In a study of the effects of quizzing frequency in an introductory physiology lecture course, Williams and Lawrence (1975) found that students given weekly quizzes preformed better on later major exams than did students not given any of these short-term quizzes.

Research into individualized courses such as PSI focused on the effect on academic performance of different module sized and frequency of mastery quizzes. For example, Semb (1974) found that the long-assignment condition (fewer quizzes) between major exams produced inferior major exam performance when compared to the short assignment (more quizzes) between major exams condition. (The short assignment condition had 16 modules, and the long condition had 8 modules).

In another study by Semb (1975), it was found that small modules (16 per semester), with mastery quizzes for each module, produced the same final exam performance as did 16 modules with mastery quizzes and four major hour exams. This indicates that requiring students to take four major hour exams during the term in addition to mastery quizzes does not increase final exam performance. To determine the effects of unit size alone, O'Neil, Johnston, Walters, and Rashed (1975) varied the sizes of study modules (or units) in an individualized course in psychology while keeping the number of mastery quizzes constant. They found that with larger modules, student performance on quizzes decreased.

Quizzing when Mastery is Not Met

Most systems and models of individualized instruction, and some traditionally structured courses, require mastery on small module quizzes (Bloom, 1968; Burger, 1975; Carroll, 1963; Keller, 1968; Postlethwait, Novak, and Murry, 1964). When students do not reach the mastery criterion specified (70%, 80%, 90%, or 100%) upon completion of the module, they usually are required to restudy and then retake a similar quiz for that module (Keller, 1968; Postlethwait, Novak, and Murry, 1964). For the prupose of this study, this method of testing that requires retesting over the entire module is referred to as a Mastery-by-Module procedure.

When students do not master module quizzes on the first attempt, this lack of mastery is reported (Hurst, 1976) to be a source of irritation or perhaps a potential threat of failure to the students. Burger (1975) describes a retesting procedure in which students are retested only on the specific objectives missed on the previous attempt. For this study, this type of testing method will be referred to as a Mastery-by-Objective procedures. Ninety percent of the students enrolled in a Mastery-by-Objective course received A or B grades. Students reported positive attitudes toward such an approach, and they recommended no changes. However, the effect of this procedure on student performance on the final examination is not reported.

In a study of audio-tutorial biology classes at Purdue, Hurst (1976) reported that some students repeated as few as two quizzes during a semester course which had 18 modules. However, other students had to repeat quizzes on as many as 16 modules once or twice, and on occasion three or more times. The number of student repeat quizzes averaged per module ranged from .14 to .78. Hurst's (1976) solution to the problem of excessively frequent retake quizzes was to institute a point format and not to require mastery for all minicourse quizzes; that is, to allow only one make-up attempt (presumably with no mastery requirement), and to have written quizzes over groups of three or four minicourses. Sample data on this alteration in format show that student

achievement varied little from the previous semester.

Semb (1974) found that shorter modules and low (60 percent) required level of performance produced fewer retake quizzes per module. However, the low mastery requirement of 60 percent for the module also produced poorer student performances on major exams. In a study of performance criteria for module mastery quizzes and their impacts on academic performance, Carlson and Minke (1975) found that the mastery criterion of module quizzes did affect student progress and the number of retake quizzes. Students tested with an 80 percent criterion completed the course more quickly and with fewer retake quizzes per module than did students tested with an ascending criterion of 60 percent to 90 percent on successive modules. O'Neil, Johnston, Walters and Rashed (1975) found that smaller modules with no accompanying changes in quiz frequency resulted in fewer retest quizzes over each module.

Student progress in the first eleven days of a course correlates highly with the total number of days to complete all mastery unit quizzes (Sutterer and Holloway, 1975). In a study of four different testing procedures, Semb, Conyers, Spencers, and Sosa (1975) found that some students achieved better with certain types of testing procedures than with other types. These studies suggest that individual differences in student progress are present, appear very early, and continue throughout the course.

Individual Differences

Differences among individuals in terms of their abilities for less than half of the variation in their academic performance (Lavin, 1965). For example, a study of individual differences of aptitude reported that mean Grade Point Average and American College Testing (ACT) scores of students earning A and B grades in a PSI course were significantly higher than those of students earning C, D, F, and W grades in that same course (Wood and Wylie, 1975). However, there were no significant differences in performances on the aptitude measures between the C grade students and the students who failed or did not complete the course.

That moderately successful students did not have measured abilities significantly different from those of unsuccessful students might lead one to speculate that factors other than ability also are involved in academic achievement. In this connection, many investigators (Cohen and others, 1969; Cope, 1969; Cosner, 1975; Johnston and Croft, 1975; Lacher, 1973; Trent and Medsker, 1968) have studied academic performance by focusing upon personality characteristics as variables.

Personality Characteristics of Community College Students

Although community and junior college students are by no means a homogeneous group, they differ overall from traditional college students. For example, Tillery (1964) surveyed characteristics of 885 students going to university

campuses and to junior colleges in California. Responses on the Omnibus Personality Inventory (OPI) indicated that the university student was higher than junior college students in intellectual motivation. The OPI showed that junior college students indicated more interest than university students in applied learning. The social maturity of the university student brought more flexibility in ideas and values than summoned by junior college students, and the junior college student was less responsive than university students to new experience.

A study directed by Tillery (Tillery and Kildegaard, 1973) followed 90,000 high school students to post-secondary schooling. Entitled the SCOPE project (School to College; Opportunities for Post-secondary Education), this study found that junior college students were lower than other college students on the OPI scale measuring autonomy and authoritarianism.

In two studies, Cohen and Brawer (1969;1970), also using the OPI, found significant differences between junior college students and the normative sample on nine of the OPI scales. Junior college students were lower than the normative sample on the OPI scales of Thinking Introversion, Theoretical Orientation, Estheticism, Social Extroversion, Personal Integration, Altruism, and Response Bias. They scored higher than the normative sample on Religious Orientation and Impulse Expression scales.

In a study utilizing SCOPE data, Cross (1971) predicted that many more students from the lowest third of scores on traditional tests of academic ability will be attending community and junior colleges in the near future. Referring to them as "New Students," Cross (1971, p. 13) has identified in them a number of personality characteristics which make them significantly different from more traditional college students. The scores of "New Students" were relatively lower on the OPI scales of Theoretical Orientation (TO) and Thinking Introversion (TI), and their scores on Impulse Expression (IE) or inability to delay gratification relatively were higher.

Personality and Achievement

In a review of research of predictors of academic performance, Lavin (1965) presents 158 studies which have explored relationships between academic performance and personality.

Studies using the Omnibus Personality Inventory (Athey and Trent, 1969; Cohen, 1969; Cohen and Brawer, 1970; Cohen and others, 1969; Dispenzieri, Kalt, and Newton, 1967; Hannah, 1969; King, 1968; Lacher, 1973; MacMillan, 1969; Smith and Winterbotton, 1970; Trent and Medsker, 1968; Weisenfeld, 1974; Wisconsin University, 1973) have found significant differences in a number of personality scale measures between unsuccessful and dropout students and students who are successful and persist in college.

Unsuccessful, suspended, and dropout students were characterized by high complexity, low autonomy, high anxiety, high impulse expression, and low personal integration.

Research using single-variable personality inventories support the conclusion that specific personality characteristics influence achievement. For example, high state anxiety is related to low achievement (Leherissey, O'Neil, Heinrich, and Hansen, 1973; Tennyson and Woolley, 1971; Tobias and Abramson, 1971). High impulsivity, or low ability to delay gratification, is related to low achievement (Krug, 1959; Merrill and Murphy, 1959; Wiegand, 1957). Adjustment, or high personal integration, is related to academic achievement (Hackett, 1960). High independence, or autonomy, is related to high achievement (Burgess, 1956; Gilmore, 1951; Merrill and Murphy, 1959).

Investigators now have begun to examine the relationships of personality to specific modes of instruction. Fitzsgerald and others (1975) found aggressiveness and final grade positively correlated for students who did not elect to use computer and slide/tape programs. Aggressiveness of students who selected computer assistance and/or slide/tape programs was negatively correlated with final grade.

In a study of self-paced instruction and college student personality traits, as measured by a Myers-Briggs type indicator, Smith and others (1973) concluded that both attitude and performance had relationships to persona-

lity traits.

Using the Sterns Activities Index, Sherill and Druger (1971) found no relationship between personality and achievement in an audio-tutorial biology course. No relationship was found between personality and performance in a computer assisted instruction course in biology, using the Junior-Senior School Personality Questionnaire (Davidoff, Diamone, and Fishman, 1971). In a research project for Nova University, Worley (1975) found no significant relationship between personality, as measured by the Edwards Personal Preference, and success in individualized study.

In a study of student preference of mode of instruction, Pascal (1971), using the Omnibus Personality Inventory found that students who chose an independent study mode rather than a lecture mode had higher autonomy (Au), higher complexity (Co), and higher thinking introversion TI) than students selecting the lecture sections.

In a study of developmental English students at the Eastern Campus of Cuyahoga Community College, Cosner (1975) found that students in English 091 had personality characteristics different from the normative sample and also from the local student norms. The OPI measured personality characteristics of developmental English students were lower than the normative sample in autonomy (Au), personal integration (PI), and complexity (Co).

Omnibus Personality Inventory Scales

The Omnibus Personality Inventory (OPI), Form F,

(Heist and Yonge, 1968) is a multivariate personality inventory developed primarily for the study of post-secondary education students. The OPI consists of 14 scales with almost 90 percent of the 385 items gleaned from previously existing instruments, mostly from the MMPI (Shoenfeldt, 1972). The OPI is not the product of an organized systematic personality theory (Heist and Yonge, 1968). Instead, it represents the interaction of a number of psychologists concerned with individual differences and personality development. In view of the overall content and its demonstrated ability to make discriminations, it has been viewed as an effective instrument (Coan, 1972; McReynolds, 1972).

Research studies using the Omnibus Personality Inventory support the premise that relatively high scores on the OPI scales of Complexity (Co), Autonomy (Au), Impulse Expression (IE), Anxiety Level (AL), and Personal Integration (PI) are specifically related to academic achievement (Athey and Trent, 1969; Cohen, 1969; Dispenzieri, Kalt, and Newton, 1967; Hannah, 1969; King, 1968; Lacher, 1973; MacMillan; 1969; Smith and Winterbotton, 1970; Trent and Medsker, 1968; Wiesenfeld, 1974; Wisconsin University, 1973). Because these scales consistently have shown to be related to achievement, they appear to be the scales which have the greatest probability of showing relationships to the achievement measures used in this study.

The OPI scales for this study are Complexity (Co), Autonomy (Au), Impulse Expression (IE), Personal Integration

(PI), and Anxiety Level (AL).

SUMMARY AND STATEMENT OF THE RESEARCH QUESTIONS

Research and literature in education support the premise that behavior technology applied to instruction has resulted in better learning (Born, Gledhill, and Davis, 1972; Keller, 1968; McMichael and Cory, 1969; Miller, Weaver, and Semb, 1974; PSI Newsletter, 1972; Shepard and MacDermott, 1970).

Research has been found to support the premise that shorter quizzes and more frequent quizzing produce better student performances on subsequent major examinations (Belzer, 1974; Semb, 1974; Semb, 1975; Stutterer and Holloway, 1975; Williams and Lawrence, 1975). Research and literature also indicate that testing procedure is still a problem in individualized instruction systems and that testing procedures need further study (Bloom, 1968; Burger, 1975; Carroll, 1963; Hurst, 1976; Keller, 1968; Semb, 1974).

Research has been found to support the premises that personality and achievement are related (Athey and Trent, 1969; Hall and Lindzey, 1957; Lavin, 1965; Stern, Stein, and Bloom, 1956), that the OPI is a useful inventory for distinguishing between successful and unsuccessful students (Cohen, 1969; Cohen and Brawer, 1970; Hannah, 1969; King, 1968; Lacher, 1973; Trent and Medsker, 1968; Wiesenfeld, 1974), and that the personality characteristics of autonomy, complexity, impulse expression, anxiety level, and personal

integration are specifically related to academic achievement (Athey and Trent, 1969; Burgess, 1956; Dispenzieri, Kalt, and Newton, 1967; Gilmore, 1951; Hackett, 1960; Krug, 1959; Leherissey, O'Neil, Heinrich, and Hansen, 1973; Merrill and Murphy, 1959; Tennyson and Woolley, 1971; Tobias and Abramson, 1971; Weigand, 1957).

Research has been found that supports the premise that students with individual personality differences will vary on achievement with different instructional techniques (Cosner, 1975; Fitzgerald and others, 1975; Pascal, 1971; Semb, Conyers, Spencer, and Soya, 1975; Smith and others, 1973; Stutterer and Holloway, 1975).

The goal of this study was to further the research into effects of personality, instructional components, and achievement within the area of instructional technology. It was anticipated that the results of the study would make significant contributions to educational experimentation at the researcher's own institution. It would provide additional research, knowledge, and perhaps a partial solution to the problem of mastery retesting and student learning.

Research Questions

The following questions were investigated in this study:

A. Is there a significant difference between the mean exam scores of students retested with Mastery-by-Objective quizzes and the mean exam scores of

students retested with Mastery-by-Module quizzes?

B. Is there a significant difference between the mean number of days to complete the module when students are retested with Mastery-by-Objective quizzes and the mean number of days to complete the module when students are retested with Mastery-by-Module quizzes?

C. Is there a significant difference between the mean number of quizzes to complete the module when students are retested with Mastery-by-Objetive quizzes and the mean number of quizzes to complete the module when students are retested with Mastery-by-Module quizzes?

D. Is there a significant difference between mean student exam scores of the two groups in Complexity (Co) and method of retesting?

E. Is there a significant difference between mean number of days to complete the module of the two groups in Complexity (Co) and method of retesting?

F. Is there a significant difference between mean number of student quizzes to complete the module of the two groups in Complexity (Co) and method of retesting?

G. Is there a significant difference between mean student exam scores of the two groups in Autonomy

(Au) and method of retesting?

H. Is there a significant difference between mean number of days to complete the module of the two groups in Autonomy (Au) and method of retesting?

I. Is there a significant difference between mean number of student quizzes to complete the module of the two groups in Autonomy (Au) and method of retesting?

J. Is there a significant difference between mean student exam scores of the two groups in Impulse Expression (IE) and method of retesting?

K. Is there a significant difference between mean number of days to complete the module of the two groups in Impulse Expression (IE) and method of retesting?

L. Is there a significant difference between mean number of student quizzes to complete the module of the two groups in Impulse Expression (IE) and method of retesting?

M. Is there a significant difference between mean student exam scores of the two groups in Personal Integration (PI) and method of retesting?

N. Is there a significant difference between mean number of days to complete the module of the two groups in Personal Integration (PI) and method of retesting?

O. Is there a significant difference between mean number of student quizzes to complete the module of the two groups in Personal Integration (PI) and method of retesting?

P. Is there a significant difference between mean student exam scores of the two groups with respect to Anxiety Level (AL) and method of retesting?

Q. Is there a significant difference between mean number of days to complete the module of the two groups in Anxiety Level (AL) and method of retesting?

R. Is there a significant difference between mean number of student quizzes to complete the module in Anxiety Level (AL) and method of retesting?

Each of these research questions generate a specific hypothesis that was tested. The hypotheses that were tested in this study appear in the next chapter, Chapter III.

CHAPTER III

PROCEDURES

Overall Design

The purpose of this study was to examine how two methods of retesting (i.e., Mastery-by-Module method or Mastery-by-Objective method) and selected personality characteristics relate to achievement in a self-paced individualized instruction module. The method of retesting and the OPI personality scales were independent variables. Although OPI personality scales were treated as independent variables, they also could have been categorized as moderator variables. The dependent variables were the post-test examination score, the number of days to complete and master (90% criterion) the module, and the number of quizzes taken to complete and master the module.

The module on the metric system of measurement used in this study was evaluated by a panel of experts and re-written based on the panel's recommendations. Specific objectives and five sets of quiz questions were written and also evaluated by the panel to insure that the quiz questions were consistent with the objectives and that quiz questions for each of the objectives were of equal

difficulty.

Students of the physical science class (N=32) were asked to volunteer to take the Omnibus Personality Inventory (OPI) (Heist and Yonge, 1968) as part of a unit which deals with value assesment and decision making in science. All of these students completed the OPI in a regular class session during the fourth week of the fall quarter of 1975. The subsequent but unrelated unit on the metric system was then introduced during the seventh week of the quarter. A pre-test which was one of the forms of the module quizzes was administered to all students in the class. The revised metric system module was taught to all students by means of an individualized instruction approach which included lectures, demonstrations, work sheets, and a mastery testing format. All students received the same lectures, demonstrations, and study sheets; during the instructional phase, all students were in the same room at the same time.

After three instructional class periods, all students were given a module test. Up to this time, all students had been afforded the same treatment. At this time, the students were randomly divided into two groups of equal size. One group was instructed to master all the objectives by a Mastery-by-Objective procedure (i.e., retest only over missed objectives). The other group was instructed to master all the objectives by a Mastery-by-Module procedure (i.e., retest over entire module if 90 percent mastery was not reached).

Field Situation

The Eastern Campus of Cuyahoga Community College opened in September 1971 as the third campus of an eight year old multi-campus community college district serving the metropolitan Cleveland, Ohio area. (Cuyahoga Community College Catalog, 1976). In September of 1975, Eastern Campus had grown to 4500 students with approximately 45 full-time faculty (Cuyahoga Community College Catalog, 1976). Many students were enrolled in the university parallel program, and there were 15 business and technical programs avialable for students (North Central Association of Colleges and Schools, 1974).

Physical Science 101, "Introduction to Physical Science" is the first of a sequence of physical science courses for non-science majors to fulfill the science requirements for an Associate degree. The Cuyahoga Community College Catalog (1975) describes 770-101, Introduction to Physical Science as:

> Introduction to Physical Science-A unified survey of the physical universe. Emphasis on scientific method, science history and modern developments. Introduces basic concepts of matter and energy, the structure of the universe through lecture-demonstration and text assignments. Lecture 3 hours. Laboratory 0 hours. Prerequisite: None. (P. 192).

Classes at the Eastern Campus are taught in typical general instruction classrooms with no special equipment for science instruction.

Study Population

The subjects (N=32) of this study were students of the day section "Introduction to Physical Science," which met three times each week, one hour each meeting, for an eleven week quarter during the fall of 1975.

The students were randomly sorted into two equal sized groups (N=16) by a method which utilized a random number table and the students' social security numbers.

The table of random numbers (Willoughby, 1973) was accessed by throwing two dice. The entry number selected was in the fifth vertical column and the tenth horizontal row. Starting with 92010 and proceeding down the column, the last two digits were matched to the last two digits of the social security numbers of the students. The next number was 32059, so any and all students with 59 as the last two digits of their social security number were placed in Group A; this procedure continued until 16 students were assigned to Group A. All remaining students were assigned to Group B.

Instrumentation

The Omnibus Personality Inventory was used to determine the personality characteristics of the students. Sets of module quiz questions tested the achievement levels of the students.

Omnibus Personality Inventory (OPI)

The Omnibus Personality Inventory (Heist and Yonge, 1968) was constructed to assess selected attitudes, values, and

interests chiefly relevant in the areas of normal ego-functioning and intellectual activity. Almost every dimension included in the OPI was chosen either for its particular relavance to academic activity or for its general importance in understanding and differentiating among students in an educational context. (Heist and Yonge, 1968).

The OPI was suitable for the present study because: (1) it is a multivariate personality inventory developed primarily for the study of post-secondary education students; (2) of its demonstrated ability to make discriminations (Coan, 1972; McReynolds, 1972); (3) of the multitude of research studies that have involved its use, (4) and of its use with community college students at the national (Tillery and Kildegaard, 1973) and local (Cosner, 1975) levels.

The norms, reported in raw-to-standard-score equivalents, are based on the responses of 7,283 entering freshman from 37 institutions of higher education in thirteen states. (Heist and Yonge, 1968).

The OPI reliability data for individual scales ranges from .67 to .89 with a mean coefficient of .83. The test-retest value is .88. (Heist and Yonge, 1968). Most scales are sufficiently stable for individual counseling or intra-individual comparisons over time (Shoenfeldt, 1972).

Research studies using the Omnibus Personality Inventory support the premise that relatively high scores on the OPI scales of Complexity (Co), Autonomy (Au), Impulse Expression (IE), Anxiety Level (AL), and personal Integration (PI) are

specifically related to academic achievement (Athey and Trent, 1969; Cohen, 1969; Dispenzieri, Kalt, and Newton, 1967; Hannah, 1969; King, 1968; Lacher, 1973; MacMillan, 1969; Smith and Winterbotton, 1970; Trent and Medsker, 1968; Wiesenfeld, 1974; Wisconsin University, 1973). Because these scales consistently have shown to be related to achievement, they appear to be the scales which have the greatest probability of showing relationships to the achievement measures used in this study.

The OPI scales (Heist and Yonge, 1968) used in this study are:

Complexity (Co) - 32 items: This measure reflects an experimental and flexible orientation rather than a fixed way of viewing and organizing phenomena. High scorers are tolerant of ambiguities and uncertainties; they are fond of novel situations and ideas. Most persons high on this dimension prefer to deal with complexity, as opposed to simplicity, and very high scorers are disposed to seek out and enjoy diversity and ambiguity.

Autonomy (Au) - 43 items: The characteristic measured by this scale is composed of liberal, non-authoritarian thinking and a need for independence. High scorers show a tendency to be independent or authority as traditionally imposed through social institutions. They oppose infringements on the rights of individuals and are tolerant of viewpoints other than their own; they tend to be realistic, intellectually and politically liberal, and much less judgmental than low scorers.

Impulse Expression (IE) - 59 items: This scale assesses a general readiness to express impulses and to seek gratification either in conscious thought or in overt action. High scorers have an active imagination value sensual reactions and feelings; very high scorers have frequent feelings of rebellion and aggression.

Personal Integration (PI) - 55 items: The high scorer admits to few attitudes and behaviors that characterize socially alienated or emotionally disturbed persons. Low scorers often intentionally

avoid others and experience feelings of hostility and aggression along with feelings of isolation, loneliness and rejection.

Anxiety Level (AL) - 20 items: High scorers deny that they have feelings of symptoms of anxiety, and do not admit to being nervous or worried. Low scorers describe themselves as tense and high-strung. They may experience some difficulty in adjusting to their social environment, and they tend to have a poor opinion of themselves. (Note the direction of scoring on this scale; a high score indicates a low anxiety level, and vice versa) (p.4).

Module Test Questions

The panel of experts (see Appendix A) used for evaluating the module's objectives and the test questions was selected based on the participant's knowledge of the metric system and their experience teaching the metric system. All were full-time or part-time faculty having at least a masters degree and presently teaching courses either that presented or used the metric system.

The module (learning unit) on the Metric System used in this study was extracted from a commercially prepared module published by Westinghouse Press entitled "Math and Science" (Hurst, 1973).

The Metric System has been very challanging to students of physical science classes. As part of the experimental design, the module was written to be difficult enough so that few, if any, students could master on the first attempt. The module, however, was not overly difficult; all of the students eventually did master the module.

Objectives for the module were rewritten in draft form

to follow the form described by Mager (1962). The panel was called together (see Appendix B) under the leadership of the researcher to critique and revise the instructional objectives. During this session, the nine instructional objectives were rewritten and received consensus approval by the panel members (see Appendix C).

During this first session, the panel members also suggested guidelines for the writing of the quiz questions. The main purpose of the quiz questions guidelines was to provide the criteria for writing quiz questions of equal difficulty within each objective. The guidelines were written and received consensus approval by the panel (see Appendix D).

The panel was informed that another meeting was necessary to critique and approve the quiz questions (see Appendix E). During this meeting, the panel was given a draft set of quiz questions. The draft questions comprised four complete tests which included two paired questions for each objective.

The panel members were asked the following questions for each set of paired quiz questions: (1) "Do these quiz questions test over the material of the instructional objective?", and (2) "Are all the paired quiz questions for this objective of equal difficulty?" (see Appendix F for sample rating sheet). The quiz questions were modified and rewritten until the panel members had consensus agreement and gave approval on all paired quiz questions (see Appendix G).

Treatment

The initial instructional phase of the module lasted three class periods. During the first class period, the module on the Metric System was introduced to the students. A short lecture was presented to all the students along with a short demonstration of the equipment used while working through the module. Students worked individually for the remainder of the first class. The instructor circulated among the students answering questions.

The second class period began with a review of the first three objectives and a question-answer session. A short lecture than followed on objectives 4,5,and 6 with students working individually for the remainder of the period.

The final session began with a review of the first six objectives and a question-answer session. A short lecture on the final three objectives was presented. Students worked individually for the remainder of the class period.

All students took their first module quiz during the fourth class period. This quiz contained two completion-type questions for each of its nine objectives. As the quiz was administered, students were informed of two retesting procedures and to which groups they were to be assigned. One group (Group A) was told they would be tested by "Mastery-by-Objective" quizzes. Group B was told they would be tested by "Mastery-by-Module" quizzes.

Both groups received the same lectures, demonstrations, and study sheets. During the instructional phase of this study, both groups were in the same room at the same time.

The only timeline or suggested pacing was that mastery over the quizzes of the module must be completed before the end of the two week period.

The "Mastery-by-Objective" students, Group A, were told they would retest only on the specific objective(s) missed on each preceeding attempt. A typical student from Group A proceeded in the following manner. On the first quiz, which was given in the fourth class period covering all the objectives, this hypothetical student mastered objectives #1,2,7, and 8. Within 24 hours the student was returned his quiz and shown what was incorrect. He then restudied the material from notes and the study sheet and signed-up to retake a quiz only over the objectives he did not master. This student could have signed up for any or all of the objectives not mastered, which in this case would be objectives #3,4,5,6, and 9. If the student then mastered all of the test items over the five objectives, he would have finished. If the student mastered only objectives #3,4, and 6, however he again would sign-up to be requizzes this time only over objectives #5, and 9. This process continued until mastery over all objectives was met.

The "Mastery-by-Module" students, Group B, were told to retest over the entire module (all objectives) each time

until they reached the mastery criterion of 90% or better. On the first quiz over the module given in class, the typical student in Group B might have received a score of 78% (14 questions correct of the 18). He was informed within 24 hours that he had not yet mastered. He was shown his quiz and what questions were incorrect. He then restudied the material from notes and the study sheet and signed up to take a similar quiz again covering all of the objectives. This process continued until mastery of 90% or better was reached on a module quiz.

After all students completed the module by their respective retesting methods, a post-test was administered to all students. The number of quizzes required to complete the module, the number of days to complete the module, the score on the post-test, and the OPI scale scores were entered on a summary sheet to permit ready access.

Limitations of the Study

(1). The size of the study sample may prevent generalization of the findings.

(2). The length of the experimental period may prevent generalization of the findings.

(3). The findings may apply only to the Physical Science Area at the Eastern Campus of Cuyahoga Community College.

Statistical Procedures and Hypotheses

Hypotheses A,B, and C were tested for a difference

between the mean achievement scores when students were retested by the two different retesting methods. For a study of the difference between the mean achievement score and method of retesting, a t-test was used. The sample size was 32. Achievement scores were on an interval scale, and method of retesting produced a dichotomy on a nominal scale. A two-tailed test was used because only a difference between means was sought.

Hypotheses D through R were tested for a difference between the mean achievement scores with respect to personality scales and method of retesting. For a study of the difference between mean achievement measures with respect to personality scales and method of retesting, a double classification, 2x2, analysis of variance was used. Analysis of variance also tested the interaction between method of retesting and personality. The sample size was 32. Achievement scores were on an interval scale, and method of retesting produced a dichotomy on a nominal scale. Personality scale scores were ranked in order of increasing score and divided into two groups at the median. The upper half was designated as "high" and the lower half designated as "low." A two-tailed test was used for only a difference between means is sought.

All statistical tests were done on a Univac 1108 utilizing the Statistical Package for the Social Science (SPSS). Subprograms "T-TEST" and ANOVA" were used for the

testing of the hypotheses. All hypotheses were generated from the research questions, and tested at the .05 level of significance.

A. (H_o): There is no significant difference between the mean exam scores of students retested with Mastery-by-Objective quizzes and the mean exam scores of students retested with Mastery-by-Module quizzes.

B. (H_o): There is no significant difference between the mean number of days to complete the module when students are retested with Mastery-by-Objective quizzes and the mean number of days to complete the module when students are retested with Mastery-by-Module quizzes.

C. (H_o): There is no significant difference between the mean number of quizzes to complete the module when students are retested with Mastery-by-Objective quizzes and the mean number of quizzes to complete the module when students are retested with Mastery-by-Module quizzes.

D. (H_o): There is no significant difference between mean student exam score of the two groups in Complexity (Co) and method of retesting.

E. (H_o): There is no significant difference between mean number of days to complete the module of the two groups in Complexity (Co) and method of retesting.

F. (H_o): There is no significant difference between mean number of quizzes to complete the module of

the two groups in Complexity (Co) and method of retesting.

G. (H_o): There is no significant difference between mean exam score of the two groups in Autonomy (Au) and method of retesting.

H. (H_o): There is no significant difference between mean number of days to complete the module of the two groups in Autonomy (Au) and method of retesting.

I. (H_o): There is no significant difference between mean number of quizzes to complete the module of the two groups in Autonomy (Au) and method of retesting.

J. (H_o): There is no significant difference between mean exam score of the two groups in Impulse Expression (IE) and method of retesting.

K. (H_o): There is no significant difference between mean number of days to complete the module of the two groups in Impulse Expression (IE) and method of retesting.

L. (H_o): There is no significant difference between mean number of quizzes to complete the module of the two groups in Impulse Expression (IE) and method of retesting.

M. (H_o): There is no significant difference between mean exam score of the two groups in Personal Integration (PI) and method of retesting.

N. (H_o): There is no significant difference between mean number of days to complete the module of the two groups in Personal Integration (PI) and method of retesting.

O. (H_o): There is no significant difference between mean number of quizzes to complete the module of the two groups in Personal Integration (PI) and method of retesting.

P. (H_o): There is no significant difference between mean exam score of the two groups in Anxiety Level (AL) and method of retesting.

Q. (H_o): There is no significant difference between mean number of days to complete the module of the two groups in Anxiety Level (AL) and method of retesting.

R. (H_o): There is no significant difference between mean number of quizzes to complete the module of two groups in Anxiety Level (AL) and method of retesting.

CHAPTER IV

RESULTS AND DISCUSSION

The results of the post-test (see Appendix H), the number of quizzes to master the module (see Appendix J), the number of days to master the module (see Appendix J), and the OPI scale scores (see Appendix K) were entered on summary sheets to permit ready access for analysis and punching the computer data cards.

Utilizing the Statistical Package for the Social Sciences (SPSS), frequencies, means, modes, medians, and standard deviations were computed for examination scores, numbers of days to master the module, and numbers of quizzes to master the module. Personality scale scores were ranked in order of increasing size and divided into two groups at the median.

In the following sections, data relevant to the hypotheses postulated in Chapter III are presented and each of the hypotheses tested. Subprograms "T-TEST" and "ANOVA" were used for testing the null hypotheses.

Hypothesis A

As shown in Table 1 and Figure 1, the post-test scores for students retested with Mastery-by-Objective

quizzes ranged from 75 to 100. Of the 16 student examination scores, seven students scored above 90 percent. Table 2 shows the mean and standard deviation to be 88.312 and 7.021, respectively.

TABLE 1

FREQUENCY DISTRIBUTION OF EXAMINATION SCORES FOR STUDENTS RETESTED WITH MASTERY BY-OBJECTIVE QUIZZES

Exam Score	Frequency	Frequency (pct)
75	1	6.3
80	1	6.3
83	4	25.1
86	2	12.5
89	1	6.3
92	3	18.8
94	2	12.5
100	2	12.5
Total	16	100.0

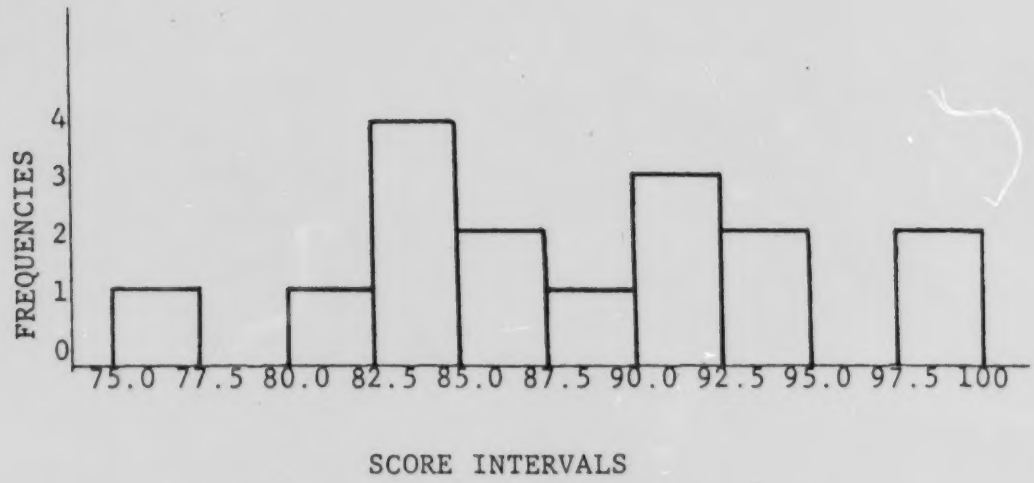

Figure 1. Histogram of Exam Scores for Students Retested with Mastery-by-Objective Quizzes

TABLE 2

MEAN, MEDIAN, MODE, AND STANDARD DEVIATION OF STUDENT POST-TEST EXAM SCORES RETESTED WITH MASTERY-BY-OBJECTIVE QUIZZES

n	16
Mean	88.312
Median	86.500
Mode	83.000
S.D.	7.021

The post-test scores of students retested with Mastery-by-Module quizzes are presented in Table 3 and Figure 2. Of these 16 student exam scores, 12 were above 90 percent. Table 4 shows the mean and standard deviation of exam scores, when students were retested with Mastery-by-Module quizzes, to be 92.687 and 6.610, respectively.

TABLE 3

FREQUENCY DISTRIBUTION OF EXAM SCORES
FOR STUDENTS RETESTED WITH
MASTERY-BY-MODULE QUIZZES

Exam Score	Frequency	Frequency (pct)
78	1	6.3
83	2	12.5
86	1	6.3
92	1	6.3
94	4	25.0
97	5	31.3
100	2	12.5

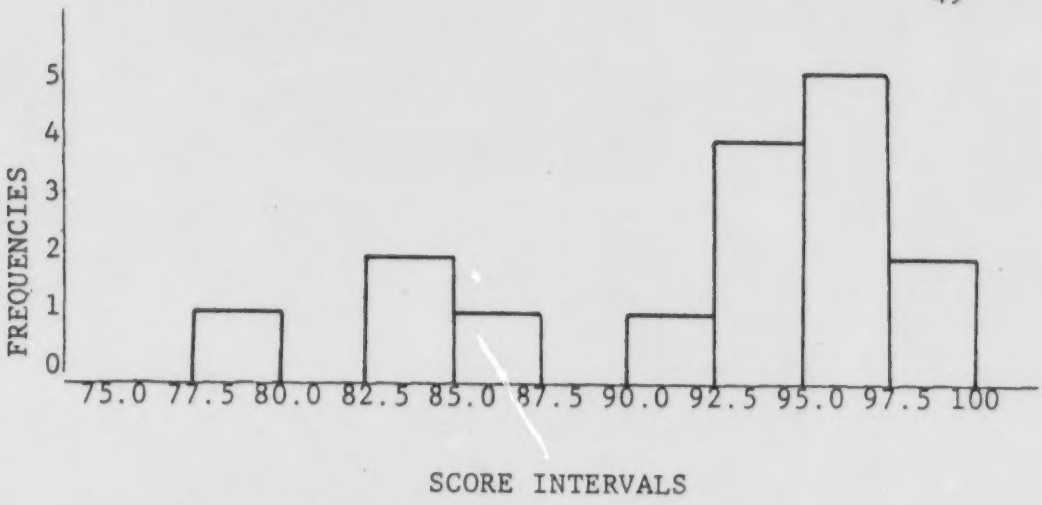

Figure 2. Histogram of Exam Scores for Students Retested with Mastery-by-Module Quizzes

TABLE 4

MEAN, MEDIAN, MODE, AND STANDARD DEVIATION OF STUDENT POST-TEST EXAMS RETESTED WITH MASTERY-BY-MODULE QUIZZES

n	16
Mean	92.687
Median	94.500
Mode	97.000
S.D.	6.610

For the relationship of post-test exam score and type of mastery retesting method, a null hypothesis of $\bar{X}_1 = \bar{X}_2$ was postulated. As shown in Table 5, a t-ratio of -1.81 was obtained and found to be nonsignificant. In view of this finding, the null hypothesis was not rejected. It was concluded that there was no significant difference between the mean exam scores of students retested with Mastery-by-Objective quizzes and the mean exam score of students retested with Mastery-by-Module quizzes.

TABLE 5

CALCULATION OF t-RATIO FOR MEAN EXAM SCORES OF STUDENTS RETESTED BY MASTERY-BY-OBJECTIVE QUIZZES OF MASTERY-BY-MODULE QUIZZES

	Mastery-by-Objective	Mastery-by-Module
n	16	16
Mean	88.3125	92.6875
S.D.	7.021	6.610
$\bar{X}_1 - \bar{X}_2$	-4.375	
t-ratio		-1.81

Hypothesis B

As shown in Table 6 and Figure 3, the number of days for students to complete the module when retested with Mastery-by-Objective quizzes ranged from nine to 15 days. Table 7 shows the mean number of days was 12.062 for students re-tested with Mastery-by-Objective quizzes.

TABLE 6

FREQUENCY DISTRIBUTION OF NUMBER OF DAYS TO COMPLETE THE MODULE FOR STUDENTS RETESTED WITH MASTERY-BY-OBJECTIVE QUIZZES

No. of Days	Frequency	Frequency (pct)
9	3	18.8
10	1	6.3
11	2	12.5
12	3	18.8
13	2	12.5
14	3	18.8
15	2	12.5
Total	16	100.0

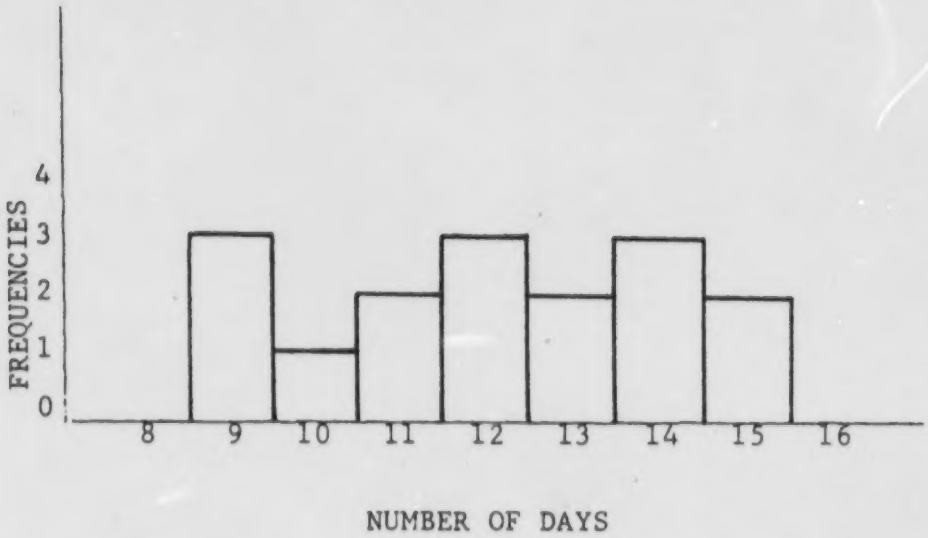

Figure 3. Histogram of Number of Days to Complete the Module when Retested with Mastery-by-Objective Quizzes

TABLE 7

MEAN, MEDIAN, MODE, AND STANDARD DEVIATION OF NUMBER OF DAYS TO COMPLETE THE MODULE WHEN RETESTED WITH MASTERY-BY-OBJECTIVE QUIZZES

n	16
Mean	12.062
Median	12.167
Mode	9.000
S.D.	2.081

As shown in Table 8 and Figure 4, the number of days for students to complete the module when retested with Mastery-by-Module quizzes ranged from eight to 16. Table 9 shows the mean to be 11.688.

TABLE 8

FREQUENCY DISTRIBUTION OF NUMBER OF DAYS TO COMPLETE THE MODULE WHEN RETESTED WITH MASTERY-BY-MODULE QUIZZES

No. of Days	Frequency	Frequency (pct)
8	3	18.8
9	2	12.5
11	1	6.3
12	3	18.8
13	4	25.0
15	2	12.5
16	1	6.3
Total	16	100.0

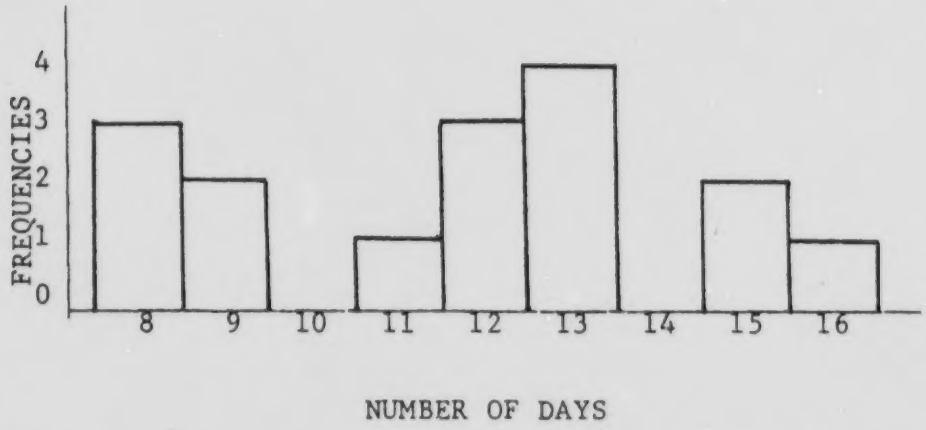

Figure 4. Histogram of Number of Days to Complete the Module when Retested with Mastery-by-Module Quizzes

TABLE 9

MEAN, MEDIAN, MODE, AND STANDARD DEVIATION OF NUMBER OF DAYS TO COMPLETE THE MODULE WHEN RETESTED WITH MASTERY-BY-MODULE QUIZZES

n	16
Mean	11.688
Median	12.167
Mode	13.000
S.D.	2.626

For the relationship of number of days to complete the module and mastery retesting method, a null hypothesis (Hypothesis B) of $\bar{X}_1 = \bar{X}_2$ was postulated. As shown in Table 10, a t-ratio of .45 was obtained and found to be nonsignificant. In view of this finding, the above null hypothesis was not rejected. It was concluded that there was no significant difference between the mean number of days for students retested with Mastery-by-Objective quizzes to complete the module and the mean number of days for students retested with Mastery-by-Module quizzes to complete the module.

TABLE 10

CALCULATION OF t-RATIO FOR MEAN NUMBER OF DAYS FOR STUDENTS TO COMPLETE THE MODULE WHEN RETESTED BY MASTERY-BY-OBJECTIVE OR MASTERY-BY-MODULE QUIZZES

	Mastery-by-Objective	Mastery-by-Module
n	16	16
Mean	12.0625	11.6875
S.D.	2.081	2.626
$\bar{X}_1 - \bar{X}_2$	.375	
t-ratio		.45

Hypothesis C

Table 11 and Figure 5 show the number of quiz attempts to complete the module of students when retested with Mastery-by-Objective quizzes. As shown in Table 12, the mean number of attempts to master the module was 3.687 and the mode was 3.000.

TABLE 11

FREQUENCY DISTRIBUTION OF NUMBER OF QUIZZES TO COMPLETE THE MODULE WHEN RETESTED WITH MASTERY-BY-OBJECTIVE QUIZZES

No. of Quizzes	Frequency	Frequency (pct)
2	1	6.3
3	7	46.8
4	5	31.3
5	2	12.5
6	1	6.3
Total	16	100.0

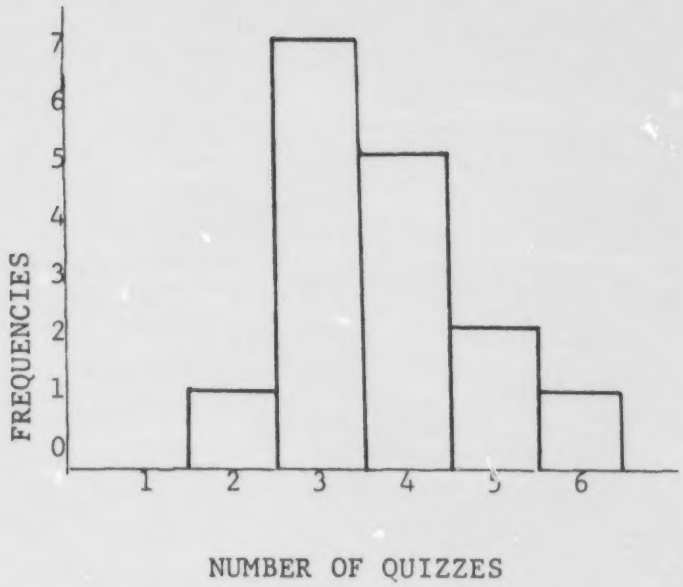

Figure 5. Histogram of Number of Quizzes to Complete the Module when Retested with Mastery-by-Objective Quizzes

TABLE 12

MEAN, MEDIAN, MODE, AND STANDARD DEVIATION OF NUMBER OF QUIZZES TO COMPLETE THE MODULE WHEN RETESTED WITH MASTERY-BY-OBJECTIVE QUIZZES

n	16
Mean	3.687
Median	3.500
Mode	3.000
S.D.	1.014

Table 13 and Figure 6 show the number of quiz attempts to complete the module of students retested with Mastery-by-Module quizzes. Table 14 shows the mean number of attempts to be 3.250 and the mode was 2.000.

TABLE 13

FREQUENCY DISTRIBUTION OF NUMBER OF QUIZZES TO COMPLETE THE MODULE WHEN RETESTED WITH MASTERY-BY-MODULE QUIZZES

No. of Quizzes	Frequency	Frequency (pct)
2	5	31.3
3	4	25.0
4	5	31.3
5	2	12.5
6	0	00.0
Total	16	100.0

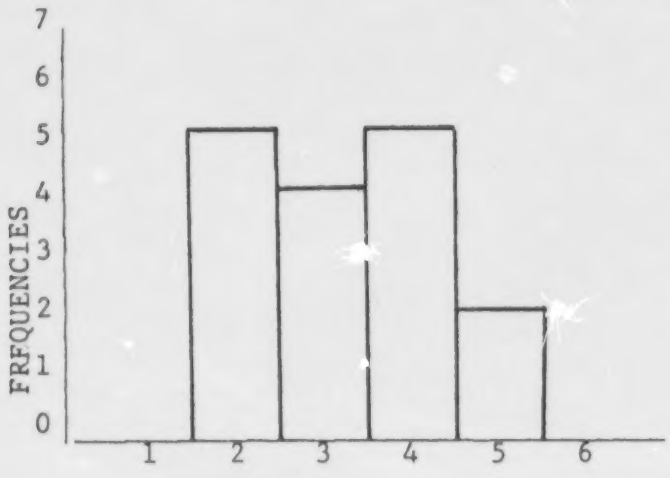

Figure 6. Histogram of Number of Quizzes to Complete the Module when Retested with Mastery-by-Module Quizzes

TABLE 14

MEAN, MEDIAN, MODE, AND STANDARD DEVIATION OF NUMBER OF QUIZZES TO COMPLETE THE MODULE WHEN RETESTED WITH MASTERY-BY-MODULE QUIZZES

n	16
Mean	3.250
Median	3.250
Mode	2.000
S.D.	1.065

For the relationship of number of quizzes attempted to achieve mastery and method of retesting, a null hypothesis (Hypothesis C) of $\bar{X}_1 = \bar{X}_2$ was postulated. As shown in Table 15 a t-ratio of 1.19 was obtained and found to be nonsignificant. In view of this finding, the above null hypothesis was not rejected. It was concluded that there was no significant difference between the mean number of quizzes for stuents retested with Mastery-by-Objective quizzes to complete the module and the mean number of quizzes for students retested with Mastery-by-Module quizzes to complete the module.

TABLE 15

CALCULATION OF t-RATIO FOR MEAN NUMBER OF QUIZZES FOR STUDENTS TO COMPLETE THE MODULE WHEN RETESTED BY MASTERY-BY-OBJECTIVE AND MASTERY-BY-MODULE QUIZZES

	Mastery-by-Objective		Mastery-by-Module
n	16		16
Mean	3.6865		3.2500
S.D.	1.014		1.065
$\bar{X}_1 - \bar{X}_2$		.4375	
t-ratio			1.19

Hypothesis D

For the relationship of mean student exam scores with respect to assessed student Complexity (Co) and method of retesting, a null hypothesis of no significance between means was postulated. As shown in Table 16, an F-ratio of 3.076, was obtained for the effects of retesting method.

A visual analysis of a matrix of mean exam scores suggested that a relationship existed between students classified as High Complexity and method of retesting. As shown in Table 17, a t-ratio of -1.83 was obtained and found to be significant at the .05 level of significance. In view of this finding, it was concluded that the mean exam score of students classified as High Complexity (Co) and retested with Mastery-by-Module quizzes was significantly higher than the

TABLE 16

CALCULATION OF F-RATIO FOR MEAN EXAM SCORES OF STUDENTS WITH RESPECT TO COMPLEXITY AND METHOD OF RETESTING

	Sum of Squares	DF	Mean Square	F
Main effects	154.828	2	77.414	1.614
Method	147.541	1	147.541	3.076
Co	1.703	1	1.703	.036
2-way interactions				
Method Co	50.104	1	50.104	1.045
Explained	204.933	3	68.311	1.424
Residual	1343.067	28	47.967	
Total	1548.000	31	49.935	

mean exam score of students classified as High Complexity (Co) and retested by Mastery-by-Objective quizzes. No other significant relationships were found.

TABLE 17

CALCULATION OF t-RATIO FOR MEAN EXAM SCORES OF STUDENTS WITH HIGH COMPLEXITY (Co) WHEN RETESTED BY THE TWO METHODS

	Mastery-by-Objective	Mastery-by-Module
n	12	7
Mean	87.667	94.286
S.D.	7.667	7.588
$\bar{X}_1 - \bar{X}_2$	6.62	
t-ratio		-1.83*

*Significant at .05 Level

Hypothesis E

For the relationship of mean number of days to complete the module with respect to assessed student Complexity (Co) and method of retesting, a null hypothesis of no significance between means was postulated. As shown in Table 18, F-ratios of .393, .349, and 3.755 were obtained for the effects of retesting method, Complexity and the two-way interaction of method and Complexity, respectively, and found to be nonsignificant. In view of these findings, the null hypothesis was not rejected. It was concluded that there was no significant difference between mean number of days to complete the module of the two groups in Complexity (Co) and method of retesting.

TABLE 18

CALCULATION OF F-RATIO FOR MEAN NUMBER OF DAYS TO COMPLETE THE MODULE WITH RESPECT TO COMPLEXITY AND METHOD OF RETESTING

	Sum of Squared	DF	Mean Square	F
Main effect	2.954	2	1.477	.282
Method	2.062	1	2.062	.393
Co	1.829	1	1.829	.349
2-way interaction Method Co	19.692	1	19.692	3.755
Explained	22.647	3	7.549	1.439
Residual	146.853	28	5.245	
Total	169.500	31	5.468	

Hypothesis F

For the relationship of mean number of student quizzes to complete the module with respect to assessed student Complexity (Co) and method of retesting, a null hypothesis of no significance between means was postulated. As shown in Table 19, F-ratios of 1.258, .000, and 1.644 were obtained for the effects of retesting method, Complexity and the two-way interaction of method and Complexity, respectively, and found to be nonsignificant. In view of these findings, the null hypothesis was not rejected. It was concluded that there was no significant difference between mean number of sutdent quizzes to complete the module of the two groups in Complexity (Co) and method of retesting.

TABLE 19

CALCULATION OF F-RATIO FOR MEAN NUMBER OF STUDENT QUIZZES TO COMPLETE THE MODULE WITH RESPECT TO COMPLEXITY AND METHOD OF RETESTING

	Sum of Squares	DF	Mean Square	F
Main effect	1.531	2	.766	.700
Method	1.376	1	1.376	1.258
Co	.000	1	.000	.000
2-way interaction Method Co	1.799	1	1.799	1.644
Explained	3.330	3	1.110	1.014
Residual	30.639	28	1.094	
Total	33.969	31	1.096	

Hypothesis G

For the relationship of mean student exam scores with respect to assessed student Autonomy (Au) and method of retesting, a null hypothesis of no significance between means was postulated. As shown in Table 20, an F-ratio of 4.613 was obtained for the effects of retesting method. A visual analysis of a matrix of mean exam scores suggested that a relationship existed between students classified as Low Autonomy (Au) and method of retesting. As shown in Table 21, a t-ratio of -1.91 was obtained and found to be significant. In view of this finding, it was concluded that the mean exam score of students classified as Low Autonomy (Au) and retested with

TABLE 20

CALCULATION OF F-RATIO FOR MEAN EXAM SCORES OF STUDENTS WITH RESPECT TO AUTONOMY AND METHOD OF RETESTING

	Sum of Squares	DF	Mean Square	F
Main effects	255.800	2	127.900	2.800
Method	210.675	1	210.675	4.613*
Au	102.675	1	102.675	2.248
2-way interaction				
Method Au	13.333	1	13.333	.292
Explained	269.133	3	89.711	1.964
Residual	1278.867	28	45.674	
Total	1548.000	31	49.935	

*Significant at .038 Level

Mastery-by-Module quizzes was significantly higher than the mean exam score of students classified as Low Autonomy (Au) and retested with Mastery-by-Objective quizzes. No other significant relationships were found.

TABLE 21

CALCULATION OF t-RATIO FOR MEAN EXAM SCORES OF STUDENTS WITH LOW AUTONOMY (Au) WHEN RETESTED BY THE TWO METHODS

	Mastery-by-Objective	Mastery-by-Module	
n	6	10	
Mean	85.167	91.800	
S.D.	6.432	7.146	
$\bar{X}_1 - \bar{X}_2$		-6.63	
t-ratio			-1.91*

*Significant at .05 Level

Hypothesis H

For the relationship of mean number of days to complete the module with respect to assessed student Autonomy (Au) and method of retesting, a null hypothesis of no significance between means was postulated. As shown in Table 22, F-ratios of .534, 1.422, and .479 were obtained for the effects of retesting method, Autonomy and the two-way interaction of method and Autonomy, respectively, and found to be nonsignificant. In view of these findings, the null hypothesis was not rejected. Therefore, it was concluded that there was no significant difference between mean number of days to complete the module of the two groups in Autonomy (Au) and method of retesting.

TABLE 22

CALCULATION OF F-RATIO FOR MEAN NUMBER OF DAYS TO COMPLETE THE MODULE WITH RESPECT TO AUTONOMY AND METHOD OF RETESTING

	Sum of Squares	DF	Mean Square	F
Main effect	9.133	2	4.567	.811
Method	3.008	1	3.008	.534
Au	8.008	1	8.008	1.422
2-way interaction Method Au	2.700	1	2.700	.479
Explained	11.833	3	3.944	.700
Residual	157.667	28	5.631	
Total	169.500	31	5.468	

Hypothesis I

For the relationship of mean number of student quizzes to complete the module with respect to assessed student Autonomy (Au) and method of retesting, a null hypothesis of no significance between means was postulated. As shown in Table 23, F-ratios of 1.822, .684, and .836 were obtained for the effects of retesting method, Autonomy and the two-way interaction of method and Autonomy, respectively , and found to be nonsignificant. In view of these findings, the null hypothesis was not rejected. Therefore, it was concluded that there was no significant difference between mean number of student quizzes to complete the module of the two groups in Autnonomy (Au) and method of retesting.

TABLE 23

CALCULATION OF F-RATIO FOR MEAN NUMBER OF STUDENT RETAKE QUIZZES TO COMPLETE THE MODULE WITH RESPECT TO AUTONOMY AND METHOD OF RETESTING

	Sum of Squares	DF	Mean Square	F
Main effect	2.283	2	1.142	1.039
Method	2.002	1	2.002	1.822
Au	.752	1	.752	.684
2-way interaction Method Au	.919	1	.919	.836
Explained	3.202	3	1.067	.971
Residual	30.767	28	1.099	
Total	33.969	31	1.096	

Hypothesis J

For the relationship of mean student exam scores with respect to assessed student Impulse Expression (IE) and method of retesting, a null hypothesis of no significance between means was postulated. As shown in Table 24, an F-ratio of 3.030 was obtained for the effects of retesting method. A visual analysis of a matrix of mean exam scores suggested that a relationship existed between students classified as High Impulse Expression (IE) and method of retesting. As shown in Table 25, a t-ratio of -1.83 was obtained and found to be significant. In view of this finding, it was

TABLE 24

CALCULATION OF F-RATIO FOR MEAN EXAM SCORES OF STUDENTS WITH RESPECT TO IMPULSE EXPRESSION AND METHOD OF RETESTING

	Sum of Squares	DF	Mean Square	F
Main effect	247.106	2	123.553	2.715
Method	137.898	1	137.898	3.030
IE	93.981	1	93.981	2.065
2-way interaction Method IE	26.591	1	26.591	.584
Explained	273.696	3	91.232	2.005
Residual	1274.303	28	45.511	
Total	1548.000	31	49.935	

concluded that the mean exam score of students classified as High Impulse Expression (IE) and retested with Mastery-by-Module quizzes was significantly higher than the mean exam score of students classified as High Impulse Expression (IE) and retested with Mastery-by-Obejctive quizzes. No other significant relationships were found.

TABLE 25

CALCULATION OF t-RATIO FOR MEAN EXAM SCORES OF STUDENTS WITH HIGH IMPULSE EXPRESSION (IE) WHEN RETESTED BY THE TWO METHODS

	Mastery-by-Objective		Mastery-by-Module
n	9		8
Mean	86.000		91.875
S.D.	6.285		6.896
$\bar{X}_1 - \bar{X}_2$		-5.88	
t-ratio			-1.83*

*Significant at .05 Level

Hypothesis K

For the relationship of mean number of days to complete the module with respect to assessed student Impulse Expression (IE) and method of retesting, a null hypothesis of no significance between means was postulated. As shown in Table 26, F-ratios of .215, .200, and .357 were obtained for the effects of retesting method, Impulse Expression and the two-way interaction of method and Impulse Expression, respectively, and found to be nonsignificant. In view of these findings, the null hypothesis was not rejected. Therefore, it was concluded that there was no significant difference between mean number of days to complete the module of the two groups in Impulse Expression (IE) and method of retesting.

TABLE 26

CALCULATION OF F-RATIO FOR MEAN NUMBER OF DAYS TO COMPLETE THE MODULE WITH RESPECT TO IMPULSE EXPRESSION AND METHOD OF RETESTING

	Sum of Squares	DF	Mean Square	F
Main effect	2.307	2	1.153	.196
Method	1.269	1	1.269	.215
IE	1.182	1	1.182	.200
2-way interaction Method IE	2.104	1	2.104	.357
Explained	4.411	3	1.470	.240
Residual	165.089	28	5.896	
Total	169.500	31	5.468	

Hypothesis L

For the relationship of mean number of student quizzes to complete the module with respect to assessed student Impulse Expression (IE) and method of retesting, a null hypothesis of no significance between means was postulated. As shown in Table 27, F-ratios of 1.385, .155, and .071 were obtained for the effects of retesting method, Impulse Expression and the two-way interaction of method and Impulse Expression, respectively, and found to nonsignificant. In view of these findings, the null hypothesis was not rejected. It was concluded that there was no significant difference between mean number of student quizzes to complete the module of the two groups in Impulse Expression (IE) and method of retesting.

TABLE 27

CALCULATION OF F-RATIOS FOR MEAN NUMBER OF STUDENT QUIZZES TO COMPLETE THE MODULE WITH RESPECT TO IMPULSE EXPRESSION AND METHOD OF RETESTING

	Sum of Squares	DF	Mean Square	F
Main effect	1.709	2	.854	.74
Method	1.591	1	1.591	1.385
IE	.178	1	.178	.155
2-way interaction Method IE	.081	1	.081	.071
Explained	1.790	3	.597	.519
Residual	32.179	28	1.149	
Total	33.969	31	1.096	

Hypothesis M

For the relationship of mean student exam scores with respect to assessed student Personal Integration (PI) and method of retesting, a null hypothesis of no significance between means was postulated. As shown in Table 28, an F-ratio of 3.041 was obtained for the effects of retesting method. A visual analysis of a matrix of mean exam scores suggested that a relationship existed between students classified as Low Personal Integration (PI) and method of retesting. As shown in Table 29, a t-ratio of -2.05 was obtained and found to be significant. In view of this finding, it was concluded that the mean exam score of students classified as Low Personal

TABLE 28

CALCULATION OF F-RATIO FOR MEAN EXAM SCORES OF STUDENTS WITH RESPECT TO PERSONAL INTEGRATION AND METHOD OF RETESTING

	Sum of Squares	DF	Mean Square	F
Main effect	158.698	2	79.349	1.680
Method	143.573	1	143.573	3.041
PI	5.573	1	5.573	.118
2-way interaction Method PI	67.175	1	67.175	1.423
Explained	225.873	3	75.291	1.595
Residual	1322.127	28	47.219	
Total	1548.000	31	49.935	

Integration (PI) and retested with Mastery-by-Module quizzes was significantly higher than the mean exam score of students classified as Low Personal Integration (PI) and retested with Mastery-by-Objective quizzes. No other significant relationships were found.

TABLE 29

CALCULATION OF t-RATIO FOR MEAN EXAMINATION SCORES OF STUDENTS WITH LOW PERSONAL INTEGRATION (PI) WHEN RETESTED BY THE TWO METHODS

	Mastery-by-Objective	Mastery-by-Module	
n	7	9	
Mean	87.143	94.333	
S.D.	7.175	6.690	
$\bar{X}_1 - \bar{X}_2$		-7.19	
t-ratio			-2.05*

*Significant at .05 Level

Hypothesis N

For the relationship of mean number of days to complete the module with respect to assessed student Personal Integration (PI) and method of retesting, a null hypothesis of no significance between means was postulated. As shown in Table 30, F-ratios of .170, .059, and 1.719 were obtained for the effects of retesting method, Personal Integration and the two-way interaction of method and Personal Integration, respectively, and found to be nonsignificant. In view of these findings, the null hypothesis was not rejected. It was concluded that there was no significant difference between mean number of days to complete the module of the two groups in Personal Integration (PI) and method of retesting.

TABLE 30

CALCULATION OF F-RATIO FOR MEAN NUMBER OF DAYS TO COMPLETE THE MODULE WITH RESPECT TO PERSONAL INTEGRATION AND METHOD OF RETESTING

	Sum of Squares	DF	Mean Square	F
Main effect	1.460	2	.730	.129
Method	.960	1	.960	.170
PI	.335	1	.335	.059
2-way interaction Method PI	9.722	1	9.722	1.719
Explained	11.183	3	3.728	.659
Residual	158.317	28	5.654	
Total	169.500	31	5.468	

Hypothesis O

For the relationship of mean number of student quizzes to complete the module with respect to assessed student Personal Integration (PI) and method of retesting, a null hypothesis of no significance between means was postulated. As shown in Table 31, an F-ratio of 3.679 was obtained for the two-way interaction of method and Personal Integration. A visual analysis of a matrix of mean number of retake quizzes suggested that a relationship existed between students classified as Low Personal Integration (PI) and method of retesting. As shown in Table 32, a t-ratio of 1.93 was obtained and found to be significant. In view of this finding, it was concluded

TABLE 31

CALCULATION OF F-RATIO FOR MEAN NUMBER OF STUDENT QUIZZES TO COMPLETE THE MODULE WITH RESPECT TO PERSONAL INTEGRATION AND METHOD OF RETESTING

	Sum of Squares	DF	Mean Square	F
Main effect	1.643	2	.821	.805
Method	1.612	1	1.612	1.579
PI	.112	1	.112	.109
2-way interaction Method PI	3.754	1	3.754	3.679
Explained	5.397	3	1.799	1.763
Residual	28.571	28	1.020	
Total	33.969	31	1.096	

that the mean number of quizzes of students classified as Low Personal Integration (PI) and retested with Mastery-by-Module quizzes was significantly lower than the mean number of quizzes of students classified as Low Personal Integration (PI) and retested with Mastery-by-Objective quizzes. No other significant relationships were found.

TABLE 32

CALCULATION OF t-RATIO FOR MEAN NUMBER OF QUIZZES OF STUDENTS WITH LOW PERSONAL INTEGRATION (PI) WHEN RETESTED BY THE METHODS

	Mastery-by-Objective		Mastery-by-Module
n	7		9
Mean	4.143		3.000
S.D.	1.215		1.118
$\bar{X}_1 - \bar{X}_2$		1.14	
t-ratio			1.93*

*Significant at .05 Level

Hypothesis P

For the relationship of mean student exam scores with respect to assessed student Anxiety Level (AL) and method of retesting a null hypothesis of no significance between means was postulated. As shown in Table 33, F-ratios of 2.308, .638, and .069 were obtained for the effects of retesting method, Anxiety Level, and the two-way interaction of method and Anxiety Level, respectively, and found to be nonsignificant. In view of these findings, the null hypothesis was not rejected. It was concluded that there was no significant difference between mean student exam scores of the two groups in Anxiety Level (AL) and method of retesting.

TABLE 33

CALCULATION OF F-RATIO FOR MEAN EXAM SCORES OF STUDENTS WITH RESPECT TO ANXIETY LEVEL AND METHOD OF RETESTING

	Sum of Squares	DF	Mean Square	F
Main effect	184.133	2	92.067	1.895
Method	112.133	1	112.133	2.308
AL	31.008	1	31.008	.638
2-way interaction Method AL	3.333	1	3.333	.069
Explained	187.467	*3	62.489	1.286
Residual	1360.533	28	48.590	
Total	1548.000	31	49.935	

Hypothesis Q

For the relationship of mean number of days to complete the module with respect to assessed student Anxiety Level(AL) and method of retesting, a null hypothesis of no significance between means was postulated. As shown in Table 34, F-ratios of .036, .895, and .052 were obtained for the effects of retesting method, Anxiety Level, and the two-way interaction of method and Anxiety Level, respectively, and found to be non-significant. In view of these findings, the null hypothesis was not rejected. It was concluded that there was no significant difference between mean number of days to complete the module of the two groups in Anxiety Level (AL) and method of retesting.

TABLE 34

CALCULATION OF F-RATIO FOR MEAN NUMBER OF DAYS TO COMPLETE THE MODULE WITH RESPECT TO ANXIETY LEVEL AND METHOD OF RETESTING

	Sum of Squares	DF	Mean Square	F
Main effect	6.333	2	3.167	.544
Method	.208	1	.208	.036
AL	5.208	1	5.208	.895
2-way interaction Method AL	.300	1	.300	.052
Explained	6.633	3	2.211	.380
Residual	162.867	28	5.817	
Total	169.500	31	5.468	

Hypothesis R

For the relationship of mean number of student quizzes to complete the module with respect to assessed student Anxiety Level (AL) and method of retesting, a null hypothesis of no significance between means was postulated. As shown in Table 35, F-ratios of 1.153, .046, and .666 were obtained for the effects of retesting method, Anxiety Level, and the two-way interaction of method and Anxiety Level, respectively, and found to be nonsignificant. In view of these findings, the null hypothesis was not rejected. It was concluded that there was no significant difference between mean number of student quizzes to complete the module of the two groups in Anxiety Level (AL) and method of retesting.

TABLE 35

CALCULATION OF F-RATIO FOR MEAN NUMBER OF STUDENT QUIZZES TO COMPLETE THE MODULE WITH RESPECT TO ANXIETY LEVEL AND METHOD OF RETESTING

	Sum of Squares	DF	Mean Square	F
Main effect	1.583	2	.792	.701
Method	1.302	1	1.302	1.153
AL	.052	1	.052	.046
2-way interaction Method AL	.752	1	.752	.666
Explained	2.335	3	.778	.689
Residual	31.633	28	1.130	
Total	33.969	31	1.096	

CHAPTER V

SUMMARY AND IMPLICATIONS

Purpose

The purpose of this study was to investigate the relationship of two methods of mastery retesting to student achievement. Certain personality characteristics were examined to determine if they relate to student achievement when students are tested by Mastery-by-Objective and Mastery-by-Module retesting methods.

Achievement measures were post-test scores, numbers of days to complete the module, and numbers of quizzes taken to complete the module.

The selected personality scales for this study, determined by the Omnibus Personality Inventory, included Complexity, Autonomy, Impulse Expression, Personal Integration, and Anxiety Level.

Procedures

The subjects (N=32) of this study were students of Introduction to Physical Science class at the Eastern Campus of Cuyahoga Community College. All subjects volunteered and took the Omnibus Personality Inventory (Heist and Yonge, 1968).

An instructional module on the metric system was selected

for the study and rewritten, with its objectives and test questions validated by a panel of local experts. All subjects of the study were afforded the same learning strategy until after the first quiz. At that time, one group (N=16) was informed they must reach mastery over each objective. The second group (N=16) was informed they must reach mastery (90 percent) over all the objectives at one time (i.e., 90 percent correct on each entire module quiz).

Summary of Results

The mean exam score of students retested with Mastery-by-Objective quizzes was 88.31, while the mean exam score of students retested with Mastery-by-Module quizzes was 92.69. A t-ratio of -1.81 was obtained and found to be nonsignificant. This t-ratio probability of .08 indicated that the differential effects of the two methods on the exam performances, while not significant, were strong enough to merit further study.

No significant difference was found between the mean number of days for students to complete the module when retested with Mastery-by-Objective quizzes and the mean number of days for students to complete the module when retested with Mastery-by-Module quizzes.

No significant difference was found between the mean number of retake quizzes for students to complete the module when retested with Mastery-by-Objective quizzes and the mean number of quizzes for students to complete the module when retested with Mastery-by-Module quizzes.

The mean exam score of students classified as High Complexity (Co) and retested with Mastery-by-Objective quizzes was significantly lower than the mean exam score of students classified as High Complexity (Co) and retested with Mastery-by-Module quizzes. All other relationships of Complexity (Co), method of retesting, and exam score were not significant.

No significant relationships were found to exist between mean number of days for students to complete the module with respect to Complexity (Co) and method of retesting.

No significant relationships were found to exist between mean number of quizzes for students to complete the module with respect to Complexity (Co) and method of retesting.

The mean exam score of students classified as Low Autonomy (Au) and retested with Mastery-by-Objective quizzes was significantly lower than the mean exam score of students classified as Low Autonomy (Au) and retested with Mastery-by-Module quizzes. All other relationships of post-test exam score with respect to Autonomy and method of retesting were not significant.

No significant relationships were found to exist between mean number of days for students to complete the module with respect to Autonomy (Au) and method of retesting.

No significant relationships were found to exist between mean number of quizzes for students to complete the module with respect to Autonomy (Au) and method of retesting.

The mean exam score of students classified as High

Impulse Expression (IE) and retested with Mastery-by-Objective quizzes was significantly lower than the mean exam score of students classified as High Impulse Expression (IE) and retested with Mastery-by-Module quizzes. All other relationships of mean post-test exam scores with respect to Impulse Expression (IE) and method of retesting were not significant.

No significant relationships were found to exist between mean number of days for students to complete the module with respect to Impulse Expression (IE) and method of retesting.

No significant relationships were found to exist between mean number of quizzes for students to complete the module with respect to Impulse Expression (IE) and method of retesting.

The mean exam score of students classified as Low Personal Integration (PI) and retested with Mastery-by-Objective quizzes was significantly lower than the mean exam score of students classified as Low Personal Integration (PI) and retested with Mastery-by-Module quizzes. All other relationships of mean post-test exam scores with respect to Personal Integration (PI) and method of retesting were not significant.

No significant relationships were found to exist between mean number of days for students to complete the module with respect to Personal Integration (PI) and method of retesting.

The mean number of retake quizzes of students classified as Low Personal Integration (PI) and retested with Mastery-

by-Objective quizzes was significantly higher than the mean number of quizzes for students classified as Low Personal Integration (PI) and retested with Mastery-by-Module quizzes. All other relationships of mean exam scores with respect to Personal Integration (PI) and method of retesting were not significant.

No significant relationships were found to exist between mean exam scores with respect to Anxiety Level (AL) and method of retesting.

No significant relationships were found to exist between mean number of days for students to complete the module with respect to Anxiety Level (AL) and method of retesting.

No significant relationships were found to exist between mean number of quizzes for students to complete the module with respect to Anxiety Level (AL) and method of retesting.

Analysis of Results

The two methods of retesting did not have significant relationships to the mean student exam scores, the mean number of days for students to complete the module, or the mean number of student quizzes to complete the module.

Analysis of the relationships of personality characteristics and retesting methods to the achievement measures revealed the following significant relationships:

(1) Students classified as High Complexity scored higher on the exam when retested with Mastery-by-Module

quizzes than when retested with Mastery-by-Objective quizzes.

(2) Students classified as Low Autonomy scored higher on the exam when retested with Mastery-by-Module quizzes than when retested with Mastery-by-Objective quizzes.

(3) Students classified as High Impulse Expression scored higher on the exam when retested with Mastery-by-Module quizzes than when retested with Mastery-by-Objective quizzes.

(4) Students classified as Low Personal Integration scored higher on the exam when retested with Mastery-by-Module quizzes than when retested with Mastery-by-Objective quizzes.

(5) Students classified as Low Personal Integration completed the module taking fewer quizzes when retested with Mastery-by-Module quizzes than when retested with Mastery-by-Objective quizzes.

The following personality scale scores of the students in this study show interdependence from the cited dependent variables and method of retesting:

(1) Anxiety Level to post-test exam scores.

(2) Complexity, Autonomy, Impulse Expression, and Anxiety Level to number of quizzes to complete the module.

(3) Complexity, Autonomy, Impulse Expression, Personal Integration, and Anxiety Level to number of days to complete the module.

General Conclusions and Implications

The findings of this study appear to justify the following general conclusions and implications. It should be recognized that the subjects in this study are not normative and that the following conclusions may not apply to students of all subject areas or all community colleges.

Testing procedures that allow students to retake only the individual objectives missed on a previous quiz (i.e., Mastery-by-Objective) are no more effective for all students than procedures that require students to retake all the objectives when mastery originally is not achieved (i.e., Mastery-by-Module). When compared to the Mastery-by-Module testing procedure students, those tested with Mastery-by-Objective procedures scored somewhat lower on the post-test, completed the module in the same length of time and retook the same number of quizzes.

Students of this study classified with the Omnibus Personality Invenory scales (Heist and Yonge, 1968) as High Complexity, Low Autonomy, High Impulse Expression, and Low Personal Integration, appear to score higher on post-test examinations when working through a module that requires retesting over the entire module as opposed to retesting only over missed objectives. It would also appear that Low Personal Integration students complete the module requiring fewer number quizzes when retested over the entire module as compared to retesting only over

missed objectives.

Research studies by Cohen and Brawer (1969;1970) and Tillery and Kildegaard (1973) report that when compared to a normative sample, community college students were lower in Personal Integration, lower in Autonomy, and higher in Impulse Expression. When compared to the Mastery-by-Objective retesting procedure, it appears that the Mastery-by-Module retesting procedure is the retesting procedure most appropriate for community college students.

Recommendation for Change

(1) Restructure the chemistry and physical science courses to a Mastery-by-Module method of retesing.

(2) Workshops should be made available to faculty emphasizing the importance of the methods of retesting.

(3) Through role as Facilitator for Individualized Instruction at Eastern Campus, suggest appropriate testing procedures.

(4) Present the findings of this study at the 1976 American Chemical Society Convention in San Francisco.

(5) Seek opportunities to present to other bodies.

(6) Explore publishing results in the Journal of Applied Behavior Analysis, Journal of Educational Psychology, and etc.

Recommendations

(1) The study should be replicated in a much larger population to determine whether findings can be generalized

further.

(2) This study should be replicated for a much greater period of time to determine whether or not the findings of this study can be generalized further.

(3) Research should be conducted in an effort to determine what influence these methods of retesting and other retesting methods have on attrition.

(4) Research should be conducted that explores the effect on achievement of the component of retesting method and other components of individualized instruction systems and their interaction with personality characteristics.

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APPENDIX A

APPENDIX A

PANEL MEMBERS

Andreas, Barbara K.	Assistant Professor of Biology B.A., M.A.
Ndyahunwoha, Gaston	Assistant Professor of Mathematics A.B., M.S.
Keen, William H.	Instrutor of Biology B.A., M.S., Ph.D.
Pira, Paul A.	Lecturer of Chemistry B.S., M.Ed.
Yarian, Ronald A.	Lecturer of Physical Science B.S., M.A.

APPENDIX B

APPENDIX B

CUYAHOGA COMMUNITY COLLEGE
EASTERN CAMPUS

INTER-OFFICE MEMORANDUM

DATE: Nov. 6, 1975

TO: Barbara Andreas
Gaston Ndyajunwoha
William Keen
Paul Pira
Ronald Yarian

FROM: Vernon K. Burger

SUBJECT: Work Session on Metric System Module

Thank you for agreeing to serve on the Metric System Module Committee. The committee will be meeting on Thursday, November 13 in the Learning Resources Center at 11:00 a.m.

APPENDIX C

APPENDIX C

METRIC SYSTEM MODULE OBJECTIVES

1. Given a base unit of the metric system, the student will be able to state which dimension the unit measures (length, volume, or weight (mass) and vice versa.

2. Given any one of the six common prefixes used with the base units of the metric system, the student will be able to state the mathematical meaning in decimal form of that prefix and vice versa.

3. Given an abbreviation of any unit(base and/or prefix) of the metric system, the student will be able to state the unit correctly and vice versa.

4. Given any measurement expressed in any units of the metric system, the student will be able to convert to any other unit of the same measure of the metric system.

5. Given any measurement expressed in units of the metric system and a conversion factor, the student will be able to convert to any other unit of the same measure in the English system and vice versa.

6. Given the dimensions of a specific item in metric units and the formula for that speciifc item, the student will be able to calculate the length, area, volume and mass (of water) of that item.

7. Given one or more of teh following items: Celsius temperature, Farenheit temperature, Kelvin temperature, Rankine temperature, and absolute zero, the student should be able to define those terms and vice versa.

8. Given a temperature measured in Celsius, Farenheit, Kelvin, or Rankine, and the conversion factor, the student will be able to convert to any other temperature scale.

9. Given a number in regular form, the student will be able to write the number in the standard form of scientific notation and vice versa.

APPENDIX D

APPENDIX D

QUIZ CONSTRUCTION GUIDELINES

1. There will be five complete quizzes over the nine objectives.

2. Each quiz will contain two questions over each objective.

3. All Mastery-by-Objective and Mastery-by-Module quizzes will have the same questions on the same attempt.

4. To assist in the writing of the paired quiz items, the following criteria are offered:

Objective 1

1. One quiz item must give the base unit of measure and ask for the measure; the other must give measure, and ask for the base unit of measure.

2. The two quiz items must be about different measures.

3. All measures are of equal difficulty.

Objective 2

1. One quiz item must give prefix name and ask for math equivalent; the other must give the math equivalent and ask for prefix name.

2. One question must contain a prefix from Column A; the other must contain a prefix from Column B.

Column A (more common)	Column B (Less common)
Kilo	Hecto
Centi	Deka
Milli	Deci

3. One quiz item must involve a prefix-equivalent greater than 1(i.e., 10,000 or 1,000); the other must involve a prefix equivalent of less than 1(i.e., 0.1, 0.01, or 0.001).

Objective 3

1. One quiz item must give the prefix and a base measure and ask for abbreviation; the other must give the abbreviation and ask for the prefix and base unit of measure.

2. One quiz item must contain a unit of measure from Column A; the other must be from Column B.

Column A	Column B
Kg	dg, dm, dl
Km	cg, cl
Cm	dkg, dkm, dkl
mm	hg, hm, hl
mg	kl
ml	

3. The two quiz items must not involve the same prefix or base unit of measure.

4. One quiz item must involve a prefix equivalent greater than 1; the other must be less than one.

Objective 4

1. One quiz item must give a measurement in a base unit of measurement and ask for the equivalent in a prefix unit; the other must give measurement in a prefix unit and ask for the equivalent in another prefix unit.

2. The two quiz items must not involve the same base unit of measure or the same prefix.

3. One quiz item must contain form Column A (see Obj.3); the other quiz item must be from Column B (see Obj. 3).

4. One quiz item must ask for a conversion from a smaller unit to a larger unit; the other must ask for a conversion from a larger unit to a smaller unit.

5. One quiz item must involve a prefix equivalent of greater than 1; the other must be less than 1.

Objective 5

1. One quiz item must give a measurement in English units ans ask for the equivalent in Metric units; the other must give a measurement in Metric units and ask for the equivalent in English units.

2. One test item must give and ask for units within the conversion factor; the other test item must give or ask for a metric unit not within the conversion factor.

3. One test item must give units and conversion factor that requires multiplication; the other test item must give units and conversion factor that requires division.

4. The two items must also not involve the same prefix or base unit.

Objective 6

1. One test item must give dimensions of 2-dimesional figure and ask for area calculation; the other test item must give dimensions of a cube and ask for volume calculation and weight if filled with water.

2. One test item must involve a conversion between units; the other must not.

3. Both questions must use mm,cm,or m only.

Objective 7

1. One test item must involve a metric system temperature scale; the other test item must involve an English system temperature scale.

2. One test item must involve an absolute scale; the other a conventional scale.

3. One test item must give a definition and ask for system name; the other must give system name and ask for definition.

Objective 8

1. One test item must give English temperature and ask for metric the other must involve conversions within systems.

2. One quiz item must give absolute temperature and ask for conventional temperature or vice versa; the other test item must give conventional temperature and ask for other conventional.

3. One quiz item must involve direct substitution; the other must involve rearranging the formula.

Objective 9

1. One quiz item must give a number in regular form and ask for the number expressed in scientific notation and ask for regular form.

2. One quiz must involve a very small number with a negative exponent; the other quiz item must involve a very large number with a positive exponent.

APPENDIX E

APPENDIX E

CUYAHOGA COMMUNITY COLLEGE
EASTERN CAMPUS

INTER-OFFICE MEMORANDUM

TO: Barbara Andreas
Gaston Ndyajunwoha
William Keen
Paul Pira
Ronald Yarian

DATE: Nov. 13, 1975

FROM: Vernon K. Burger

SUBJECT: Work Session on Metric System Module

The committee will meet on Thursday, November 20, in the Tutoring Center at 11:00 a.m.

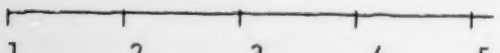
APPENDIX F

APPENDIX F

QUIZ ITEM RATING SHEET

OBJECTIVE ____

Agreement with objective



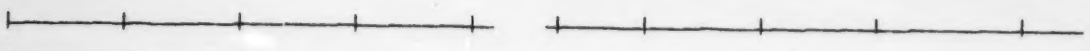
1 None 2 Little 3 Some 4 To a Great Extent 5 Comp. Agreement

Agreement with guidelines

1 None 2 Little 3 Some 4 To a Great Extent 5 Comp. Agreement

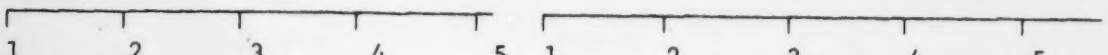
Quiz 1

Item 1



1 2 3 4 5 1 2 3 4 5

Item 2

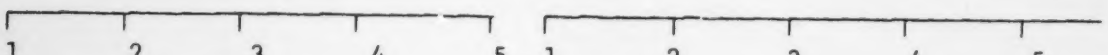


1 2 3 4 5 1 2 3 4 5

If not 5, why not? If not 5, why not?

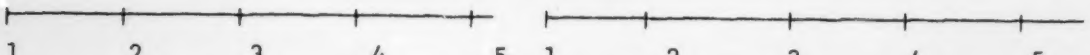
Quiz II

Item 1



1 2 3 4 5 1 2 3 4 5

Item 2



1 2 3 4 5 1 2 3 4 5

If not 5, why not? If not 5, why not?

Quiz III

Item 1

1 2 3 4 5	1 2 3 4 5

Item 2

1 2 3 4 5	1 2 3 4 5
If not 5, why not?	If not 5, why not?

Quiz IV

Item 1

1 2 3 4 5	1 2 3 4 5

Item 2

1 2 3 4 5	1 2 3 4 5
If not 5, why not?	If not 5, why not?

Quiz V

Item 1

1 2 3 4 5	1 2 3 4 5

Item 2

1 2 3 4 5	1 2 3 4 5
If not 5, why not?	If not 5, why not?

Are all quizzes now of equal difficulty? Yes____ No____

APPENDIX G

APPENDIX G

QUIZ ITEMS

OBJECTIVE 1

Quiz I

1. What is the base unit of the metric system for the measurement of mass?

2. The base unit of the metric system the "liter" is a measurement of what quantity?

Quiz II

1. What is the base unit of the metric system for the measurement of volume?

2. The base unit of the metric system the "meter" is a measurement of what quantity?

Quiz III

1. What is the base unit of the metric system for the measurement of mass?

2. The base unit of the metric system the "meter" is a measurement of what quantity?

Quiz IV

1. What is the base unit of the metric system for the measurement of volume?

2. The base unit of the metric system the "meter" is a measurement of what quantity?

Quiz V

1. What is the base unit of the metric system for the measurement of length?

2. The base unit of the metric system the "gram" is a measurement of what quantity?

OBJECTIVE 2

Quiz I

1. What is the mathematical meaning of the prefix hecto?
2. The mathematical meaning of .01 is assigned to what prefix?

Quiz II

1. What is the mathematical meaning of the prefix milli?
2. The mathematical meaning of 10X is assigned to what prefix?

Quiz III

1. What is the mathematical meaning of the prefix deci?
2. The mathematical meaning of 1000X is assigned to what prefix?

Quiz IV

1. What is the mathematical meaning of the prefix milli?
2. The mathematical meaning of 10X is assigned to what prefix?

Quiz V

1. What is the mathematical meaning of the prefix centi?
2. The mathematical meaning of 100X is assigned to what prefix?

OBJECTIVE 3

Quiz I

1. What does the abbreviation ml stand for?
2. What is the abbreviation for dekagram?

Quiz II

1. What does the abbreviation hg stand for?
2. What is the abbreviation for centimeter?

Quiz III

1. What does the abbreviation dg stand for?
2. What is the abbreviation for kilometer?

Quiz IV

1. What does the abbreviation hl stand for?

2. What is the abbreviation for milligram?

Quiz V

1. What does the abbreviation cl stand for?

2. What is the abbreviation for killogram?

OBJECTIVE 4

Quiz I

1. What is the equivalent of 25 hectometers in meters?

2. What is the equivalent of 150mg in decigrams?

Quiz II

1. What is the equivalent of 15 liters in centiliters?

2. What is the equivalent of 1500 milligrams in dekagrams?

Quiz III

1. What is the equivalent of 35 dekaliters to liters?

2. What is the equivalent of 1500 decimeters in hectometers?

Quiz IV

1. What is the equivalent of 15 liters in milliliters?

2. What is the equivalent of 1500 decigrams in dekagrams?

Quiz V

1. What is the equivalent of 35 centiliters in dekaliters?

2. What is the equivalent of 1500 kilograms in grams?

OBJECTIVE 5

Quiz I

1. One ince equal to 2.54cm. To the nearest inch, how many inches are in 2.3 meters?

2 . One pound is equal to 454 grams. To the nearest gram, how many grams in 5.0 lbs?

Quiz II

1. One liter is equal to 1.06 quarts. To the nearest milliliter how many milliliters are in 2.0 quarts?

2. One yard is equal to .914 meters. To the nearest meter how many meters in 150 yards?

Quiz III

1. One foot is equal to 30.5cm. To the nearest centimeter, how many centimeters are in 3.0 feet?

2. One liter is equal to 1.056 quarts. To the nearest quart how many quarts in 110 milliliters?

Quiz IV

1. One liter is equal to 1.06 quarts. To the nearest milliliter, how many milliliters are in 4.0 quarts?

2. One yard is equal to .914 meters. To the nearest meter, how many meters in 25 yards?

Quiz V

1. One kilogram is equal to 2.2 lbs. To the nearest kilogram, how many kilograms are in 110 lbs?

2. ONe mile is equal to 1.6 kilometers. To the nearest meter, how many meters are in 150 miles.

OBJECTIVE 6

Quiz I

1. A circle has a radius of 15mm. What would the area of this circle be expressed in cm^2? (Area of circle is $3.14 \times r^2$),

2. A cube measures 25cm along each side. What is the volume in cm^3 of the cube? IF filled with water, what would that volume of water weigh expressed in grams? (Volume of cube = s3).

Quiz II

1. A triangle has the dimensions of 150cm and 300cm for the base and height respectiyely. Wht is the area of the triangle expressed in cm^2? (Area of triangle= 1/2 b x h).

2. A cube measures 25m along each side. What is the volume in cm^3 of the cube? If filled with water, what would that volume of water weigh expressed in grams? (Volume of Cube = s^3).

Quiz III

1. A rectangle has the dimensions of 150cm and 300cm for the length and width respectively. What is the ares of the rectangle expressed in cm^2? (Area of rectangle = l x w).

2. A cube measures 15cm along each side. What is the volume in cm^3 of the cube? If filled with water, wht would that volume weigh expressed in grams? (Volume of cube= s^3).

Quiz IV

1. A triangle has the dimensions of 25mm and 30mm for the base and height respectively. What is the area of the triangle expressed in cm^2? (Area of triangle =1/2 b x h).

2, A cube measures 40cm along each side. What is the volume in cm^3 of the cube? IF filled with water, what would that volume of water weigh expressed in grams? (Volume of cube = s^3).

Quiz V

1. A rectangle has the dimensions of 20mm and 600mm for the length and width respectively. What is the area of the retangle expressed in cm^2? (Area of rectangle l x w).

2. A cube measures 4.0cm along each side. What is the volume in cm^3 of the cube? If filled with water what would that volume of water weigh expressed in grams? (Volume of Cube = s^3).

OBJECTIVE 7

1. Which temperature scale has 32° as the freezing point of water and 212° as the boiling point?

2. Define Kelvin temperature?

Quiz II

1. Which temperature scale has 0° as the freezing point of water and 100° as the boiling point?

2. Define absolute zero.

Quiz III

1. Which temperature scale has a zero point as absolute zero and scale divisions equal to those of the Farenheit scale?

2. Define Celsius temperature scale.

Quiz IV

1. Which temperature scale has 0^{o} as the freezing point of water and 100^{o} as the boiling point?

2. Define Rankine temperature scale.

Quiz V

1. Which temperature scale has a zero point at absolute zero and scale divisions equal to those of the Celsius scale?

2. Define absolute zero.

OBJECTIVE 8

Quiz I

1. Given the formula $^{o}C = 5/9(^{o}F - 32^{o})$ what is $60^{o}F$ equal to?

2. Given the formula $^{o}K = {}^{o}C + 273$, what is $300^{o}K$ equal to in ^{o}C?

Quiz II

1. Given the formula $^{o}F = 9/5C + 32$, what is $15^{o}C$ equal to?

2. Given the formula $^{o}R = {}^{o}F + 460^{o}F$, what is $500^{o}R$ equal to in ^{o}F?

Quiz III

1. Given the formula $^{o}C = 5/9(F-32)$, what is $104^{o}F$ equal to in ^{o}C?

2. Given the formula $^{o}K = {}^{o}C + 273$, what is $500^{o}K$ equal to in ^{o}C?

Quiz IV

1. Given the formula $^{o}F = 9/5C + 32$, what is $35^{o}C$ equal to?

2. Given the formula $^{o}R = {}^{o}F + 460^{o}F$ what is $70^{o}F$ equal to in ^{o}R?

Quiz V

1. Given the formula $^{o}C = 5/9(F - 32)$, what is $80^{o}F$ equal to in ^{o}C?

2. Given the formula $^{o}R = {}^{o}F + 460$, what is $600^{o}R$ equal to in ^{o}F?

OBJECTIVE 9

Quiz I

1. Express 12,340,000,000 in scientific notation.

2. Express 2.76×10^{-7} in regular form.

Quiz II

1. Express .000034 in standard form of scientific notation.

2. Express 2.76×10^{6} in regular form.

Quiz III

1. Express 273,000,000 in standard form of scienctific notation.

2. Express 2.76×10^{-6} in regular form.

Quiz IV

1. Express .000000014 in standard form of scientific notation.

2. Express 9.3×10^{7} in regular form.

Quiz V

1. Express 0.000000031 in standard form of scientific notation.

2. Express 6.14×10^{4} in regular form.

APPENDIX H

APPENDIX H

FREQUENCY DISTRIBUTION OF 32 STUDENT
POST-TEST EXAM SCORES

Interval	Frequency	Frequency (pct)
75	1	3.1
78	1	3.1
80	1	3.1
83	6	18.7
86	3	9.4
89	1	3.1
92	4	12.5
94	6	18.7
97	5	15.6
100	4	12.5
Total	32	100.0

MEAN, MEDIAN, MODE, AND STANDARD DEVIATION OF COMBINED POST-TEST EXAM SCORES

Statistic	Value
n	32
Mean	90.500
Median	92.250
Mode	83.000 and 94.000
S.D.	7.067

APPENDIX I

APPENDIX I

FREQUENCY DISTRIBUTION OF NUMBER OF DAYS TO COMPLETE THE MODULE

Interval	Frequency	Frequency (pct)
8	3	9.4
9	5	15.6
10	1	3.1
11	3	9.4
12	6	18.8
13	6	18.8
14	3	9.4
15	4	12.5
16	1	3.1
Total	32	100.0

MEAN, MEDIAN, MODE, AND STANDARD DEVIATION OF COMBINED NUMBER OF DAYS TO COMPLETE THE MODULE

Statistics	Value
n	32
Mean	11.875
Median	12.167
Mode	12.000 and 13.000
S.D.	2.338

APPENDIX J

APPENDIX J

FREQUENCY DISTRIBUTION OF NUMBER OF QUIZZES TO COMPLETE THE MODULE

Interval	Frequency	Frequency (pct)
2	6	18.8
3	11	34.4
4	10	31.3
5	4	12.5
6	1	3.1
Total	32	100.0

MEAN, MEDIAN, MODE, AND STANDARD DEVIATION OF NUMBER OF QUIZZES TO COMPLETE THE MODULE

Statistic	Value
n	32
Mean	3.469
Median	3.409
Mode	3.000
S.D.	1.047

APPENDIX K

APPENDIX K

OPI SCALE SCORES OF 32 STUDENTS

FREQUENCY DISTRIBUTION OF STUDENT COMPLEXITY SCORES

Interval	Frequency	Frequency (pct)	Cum. Frequency
35	1	3.1	3.10
37	1	3.1	6.30
39	1	3.1	9.40
40	2	6.3	15.60
44	2	6.3	21.90
46	2	6.3	28.10
47	1	3.1	31.30
48	2	6.3	37.50
50	1	3.1	40.60
51	4	12.5	53.10
53	1	3.1	56.30
59	2	6.3	62.50
60	1	3.1	65.60
62	1	3.1	68.80
64	1	3.1	71.90
67	1	3.1	75.00
68	2	6.3	81.30
70	2	6.3	87.50
73	3	9.4	94.90
75	1	3.1	100.00

FREQUENCY DISTRIBUTION OF STUDENT AUTONOMY SCORES

Interval	Frequency	Frequency (pct)	Cum. Frequency
21	1	3.1	3.10
40	3	9.4	12.50
41	1	3.1	15.60
46	2	6.3	21.90
47	1	3.1	25.00
49	1	3.1	28.10
52	3	9.4	37.50
53	2	6.3	43.80
54	2	6.3	50.00
55	1	3.1	53.10
57	2	6.3	59.40
58	2	6.3	65.60
59	1	3.1	68.80
60	1	3.1	71.90
61	1	3.1	75.00
62	1	3.1	78.10
63	3	9.4	87.50
64	2	6.3	93.80
66	1	3.1	96.90
67	1	3.1	100.00

FREQUENCY DISTRIBUTION OF STUDENT IMPULSE EXPRESSION SCORES

Interval	Frequency	Frequency (pct)	Cum. Frequency
41	1	3.1	3.10
42	1	3.1	6.30
46	1	3.1	9.40
47	1	3.1	12.50
50	2	6.3	18.80
51	1	3.1	21.90
52	2	6.3	28.10
53	1	3.1	31.30
54	2	6.3	37.50
55	1	3.1	40.60
59	1	3.1	43.80
63	1	3.1	46.90
64	2	6.3	53.10
65	2	6.3	59.40
66	4	12.5	71.90
67	2	6.3	78.10
68	1	3.1	81.30
69	1	3.1	84.40
72	1	3.1	87.50
74	2	6.3	93.80

FREQUENCY DISTRIBUTION OF STUDENT
ANXIETY LEVEL SCORES

Interval	Frequency	Frequency (pct)	Cum. Frequency
25	1	3.1	3.10
26	1	3.1	6.30
28	2	6.3	12.50
32	1	3.1	15.60
33	1	3.1	18.80
35	1	3.1	21.90
39	2	6.3	28.10
42	4	12.5	40.60
45	2	6.3	46.90
46	1	3.1	50.00
47	2	6.3	56.30
49	2	6.3	62.50
52	1	3.1	65.60
54	2	6.3	71.90
56	3	9.4	81.30
57	2	6.3	87.50
58	1	3.1	90.60
60	1	3.1	93.80
61	2	6.3	100.00

FREQUENCY DISTRIBUTION OF STUDENT
PERSONAL INTEGRATION SCORES

Interval	Frequency	Frequency (pct)	Cum. Frequency
28	1	3.1	3.10
30	1	3.1	6.30
31	1	3.1	9.40
32	2	6.3	15.60
37	1	3.1	18.80
41	1	3.1	21.90
42	1	3.1	25.00
43	1	3.1	28.10
44	1	3.1	31.30
46	2	6.3	37.50
49	1	3.1	40.60
50	1	3.1	43.80
51	1	3.1	46.90
52	1	3.1	50.00
53	1	3.1	53.10
54	1	3.1	56.30
55	2	6.3	62.50
57	1	3.1	65.60
58	2	6.3	71.90
59	2	6.3	78.10